Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LV. OCTOBER, 1918. No. 4.

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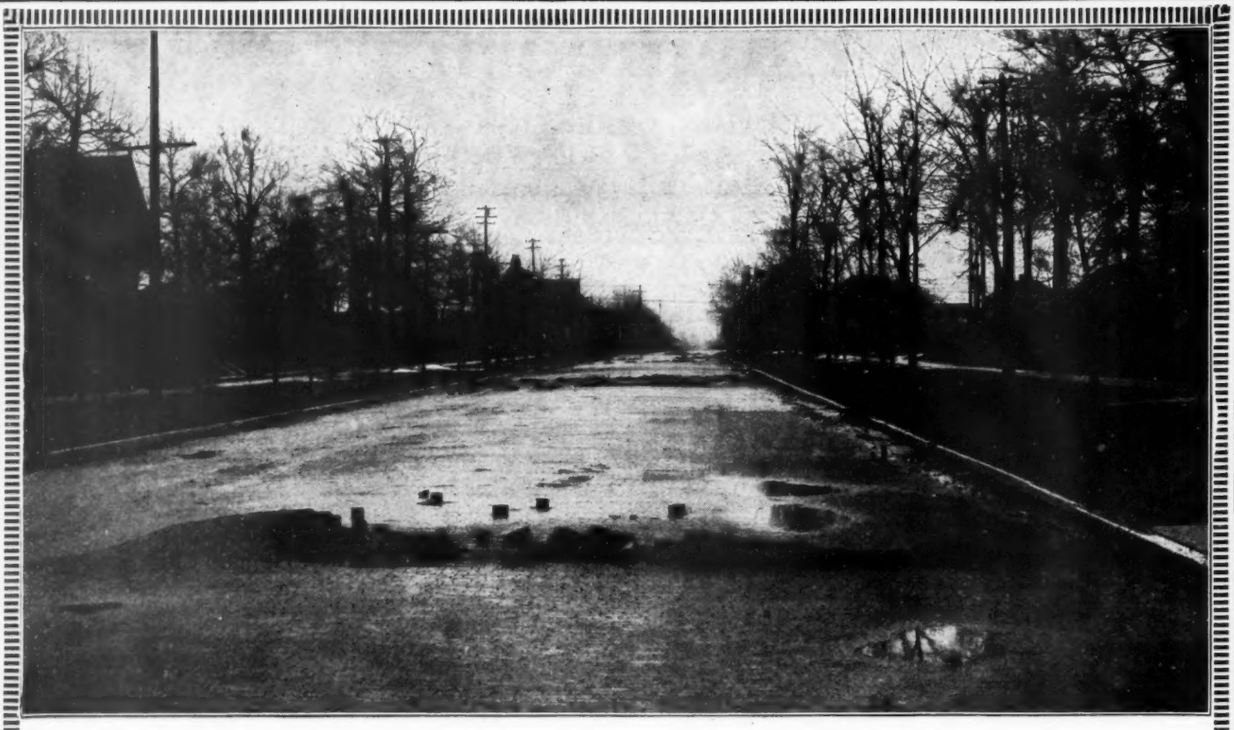
MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. FOX, President; J. H. Pritchard, Secretary.

The Editorial and Advertising Offices are at 538 S. Clark St., CHICAGO, ILLINOIS. Samuel C. Hadden, Editor. Louis McLouth, Advertising Manager. A. L. Marsh, Eastern Manager, 30 Church St., New York.

Single copies, 25 cents. The yearly subscription price in the United States and its Possessions, Cuba and Mexico, is $2.00; in Canada, $2.40; and in all other countries, $2.75.

Entered as second-class matter July 1, 1899, at the Post Office at Indianapolis, Indiana, under the Act of March 3, 1879.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should be addressed to 538 S. Clark St., Chicago, Illinois.



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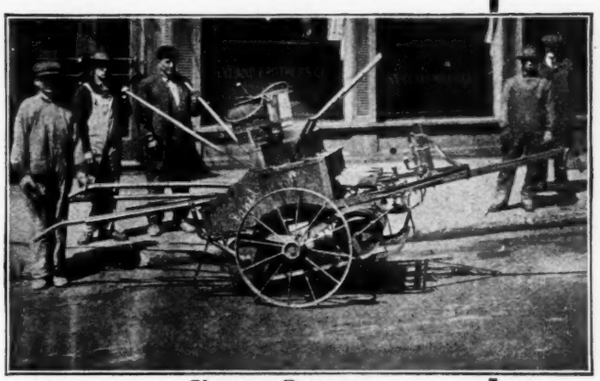

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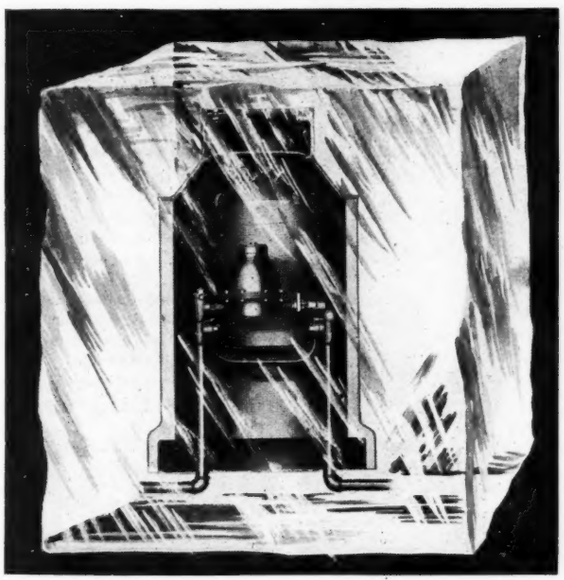

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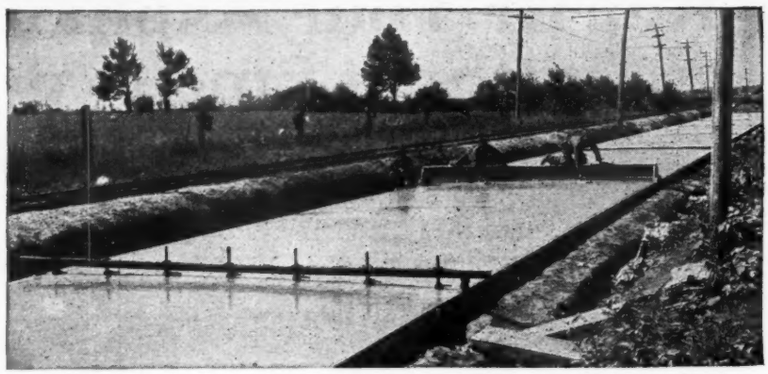

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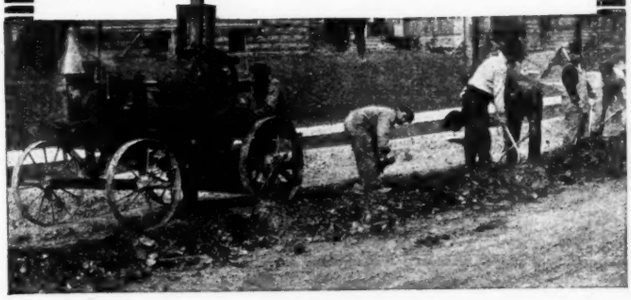

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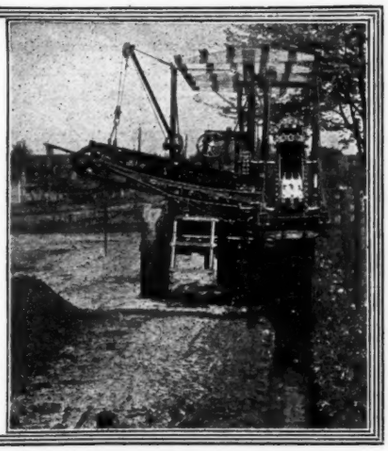

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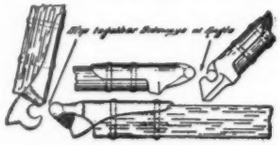

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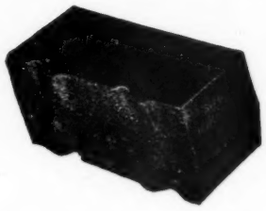

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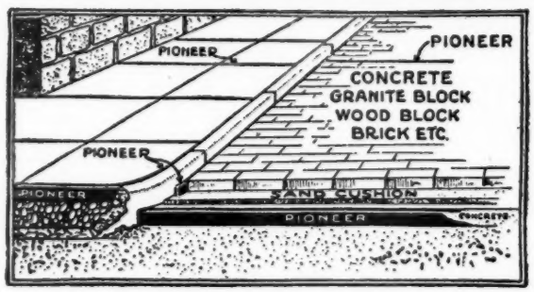

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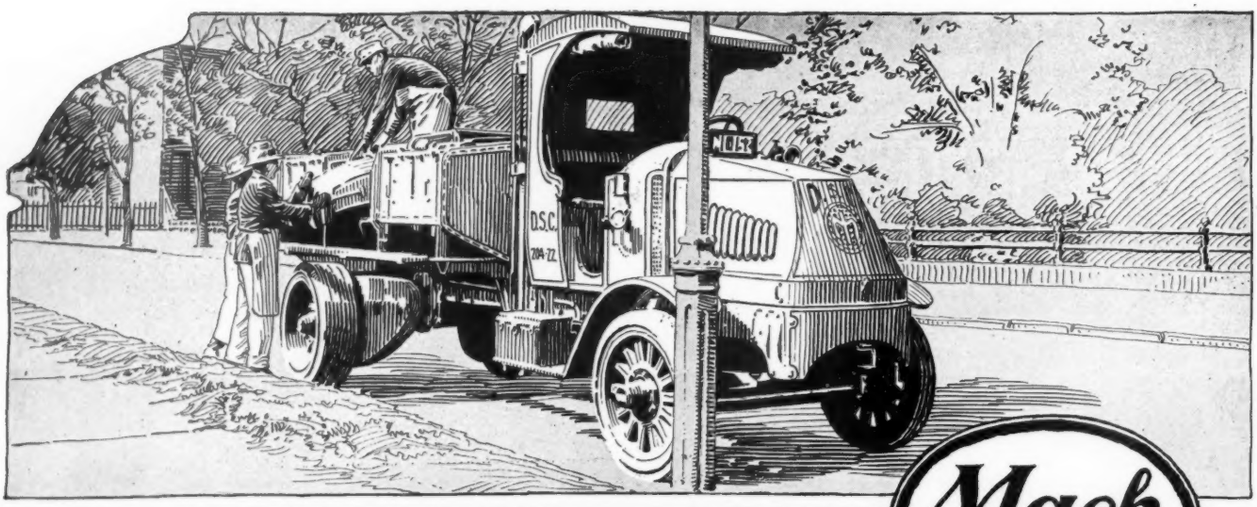

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All-year utility is represented in the MACK double service municipal equipment shown herewith.

New York City's Street Cleaning Department has a large fleet of MACK trucks, with chasses convertible for two distinct and opposite tasks.

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Formerly it was necessary to lay up flushers and sprinklers during the winter months, representing a considerable loss on the truck investment. New York City and other cities of equal progressiveness can capitalize on their investments by purchasing MACK trucks with all their favorable features for the interchange of body equipment and the attachment of special municipal adjuncts.

MACK trucks in sizes 1—7½ tons. Tractors, 5—7—11—15 tons.

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Everlastin' Team Work

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As manufacturers of a product which alike meets the needs of a nation at war and the needs of individual Americans engaged in essential industry, the General Motors Truck Company owes this expression of appreciation to those whose orders have been delayed. And the spirit with which these prospective customers have bowed to the greater needs of the war is hereby gratefully acknowledged.

Either directly or through priority orders, those loyal Americans whose manufactured products may be utilized for war purposes are giving the government first call, and we, being in that class from the standpoint of production, are in turn, dependent on those who produce the raw materials that go into our own finished product.

So two conditions stand in the way of deliveries—factory production is curtailed by scarcity of material, and output for industrial needs is limited by government demand.

Could we run the factory at capacity both demands might be filled with reasonable promptness.

Until this situation improves, however, we ask the indulgence of all GMC customers—those who already own GMC Trucks and those who seek to buy.

"The everlastin' team work of every bloomin' soul", as Kipling puts it, will solve the problem—will bring about the day when war will be no more; when peaceful industry may resume the development which war has so ruthlessly interrupted.

GENERAL MOTORS TRUCK COMPANY

One of the units of the General Motors Corporation

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(415)

GMC TRUCKS

MOTOR TRUCK OPERATION AND ACCOUNTING XXXVIII

With the approach of cold weather it is highly probable that at least a partial paralysis of railroad transportation again impends. The motor truck, operating over the highways for both short and long hauls, will respond to the call for help that railroad operating officers will again issue as they did last winter.

Performance of Gramm-Bernstein Tractors with Trailers

The paragraphs immediately following are from a letter to the editor written by Mr. H. G. Metzler, sales manager for the Stratton-Gramm-Bernstein Truck Co., of Chicago, and are based on the performance of a trucking concern in Chicago operating two 5-ton Gramm-Bernstein Tractors with 24 ft. trailers on each:

"The trailer chassis is 22½ ft. long, the body 24 ft. long, of the stake type, being 8 ft. wide and 7 ft. high. The trucking concern are engaged in important hauling on intercity work, and average 1½ trips per day, a distance each way of 50.1 miles, carrying with them a 5-ton load, their time average being 4 hrs. per trip with a gas consumption of 8 gals. and an oil consumption of 2 qts. On each one of these trailers they carry approximately 165 cases, the sizes being 18x24x36 ins.

"Reports that we have had from the owners claim that the units have been working every day and although covering over 3,500 miles a month each, they are not going anywhere near their full capacity. The truckers also state that the equipment has given service which they believed impossible for a truck. Exact figures that correspond with the ones given can be had by any interested person.

"We are giving you herewith the cost of operation on each of the 5-ton Gramm-Bernstein tractors equipped with 24-ft. trailers and based on a price higher than that which was paid for the equipment. You will find that this cost of operation is figured very liberally and anyone conservative in the operation of trucks can readily cut this expense.

Cost of Operating 5 to 6-Ton Gramm-Bernstein Tractor

Investment—

Tractor with Service Trailer and Body	$5,000.00
Tires—	
Front Wheels	$ 76.45
Rear Wheels	152.90
Trailer Wheels	152.90
	$ 382.25
Fixed Charges—	
Interest at 6%	$ 150.00
Depreciation (less tires) 12½%	577.22
Driver @ $30.00 per week	1,560.00
Garage @ $15.00 per month	180.00
Fire Insurance	25.00
Public Liability (Class 3B)	75.00
Total Fixed Charges	$2,567.22
Fixed Charges per day (300 days)	$ 8.55
Uniform Variable Charges—	
Tires—8,000 miles (or more)	$ .0477
Gasoline—6.5 miles per gal. @ $ .23	.0353
Motor Oil—100 miles per gal. @ $ .40	.0040
Heavy Oil, Grease, etc.	.0013
Total Uniform Variable Charges per mile	$ .0883
Maintenance, Replacements and Annual Overhaul	$300.00
Daily mileage—150 miles.	
One way load—5 tons.	
Return trip empty.	
Operating Cost per mile—	
Fixed Charges	$ .0570
Uniform Variable Charges.	.0883
Maintenance and Overhaul	.0066
	$ .1519

Cost per day—$22.78.

Load is hauled 75 miles, making 375 ton miles per day at a cost of $22.78 or $ .0607 per ton mile.

Were circumstances such that these tractors could haul a return load, this ton-mile cost could be cut in two.

G M C 1½-TON TRUCK, RUNNING FULLY LOADED, FROM SEATTLE, WASH., TO NEW YORK, N. Y., IN 31 DAYS.

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To meet wartime demands for the conservation of time, money and man-power on necessary municipal work, officials will find the Service Motor Truck an invaluable ally.

A pioneer truck with an established reputation on municipal transportation jobs of practically every kind—sprinkling, flushing, oiling, light and heavy hauling.

Dependable, economical, trouble-free performance assured by the fact that Service Trucks have been delivering this kind of service for the past eight years.

Service
MOTOR TRUCKS

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Service Motor Truck Company

Dept. M-3. **WABASH, INDIANA**

Distributors in all principal cities.

"You will also note that these trucks are not hauling return loads due to the fact that they cannot await loading of such loads, thereby losing time which would interfere with their schedule of delivery. However, in the event that they could carry return loads with them, their cost of operation per ton mile would be cut one-half, which should enable anybody to see that *inter-city hauling is profitable when properly conducted.*

"We are at this time figuring with a number of parties for the installation of inter-city traffic on even a larger scale than this and have gotten together some interesting data showing the cost of operations, proposed profits, schedule of time and return loads.

"We believe that inter-city hauling with trucks will eventually be as large between close points as rail handling of freight on a comparative basis, and there can be no doubt but that truck handling of freight gives a more prompt delivery in less time than the railroads can handle it at a lesser cost when all is considered, and at the same time making delivery to the consignee's door.

"The expense and service on this Gramm-Bernstein equipment has been so nominal that if it were taken on a percentage basis at the cost of the equipment, it would have to be figured in decimals.

"It is not necessary to go into detail regarding the continuous operation of these trucks as the trucker's statement of over 3,500 miles a month being covered is enough to prove to anyone that they have had to operate continuously and with uninterrupted service in order to have negotiated this mileage. We do not know of a single instance where these trucks have been held up at any time for repairs.

"We believe in the very near future that you will see even a greater number of trucks and trailers doing inter-city hauling as well as long distance hauls in cities with large loads using the trailer for the purpose of greater deliveries at the minimum expense."

Acme Trucks in Intercity Haulage in Colorado

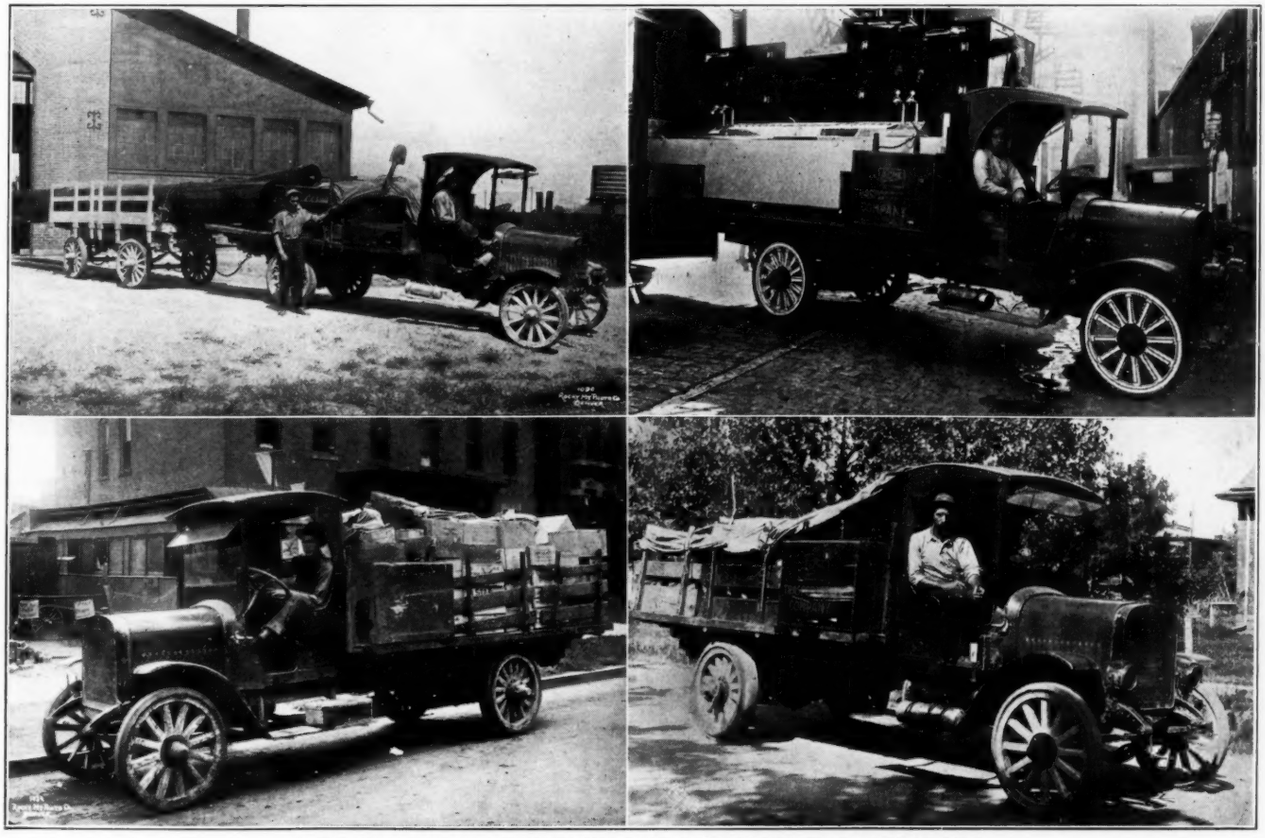
In one of the composite illustrations herewith there is shown a view of an Acme truck, operated by the Acme Transportation Co., taking a 96 ft. smoke stack from Denver to Greeley, Colo., a distance of 55 miles. The same truck is shown en route from Denver to Loveland, transporting a soda fountain weighing 5,000 lbs. This was taken a distance of 60 miles over rough mountain roads. Another view illustrates a truck on a regular trip from Denver to Greeley, carrying a mixed load of groceries. The truck makes six round trips between these two cities each week. The round trip is 110 miles. The fourth view shows a return load of 17 live sheep hauled from Greeley to the Denver stock yards.

The return load movement is gradually growing on this Denver-Greeley route, though at first the people who should have been interested were rather indifferent, but now the "going" is much easier.

It will be noticed that these trucks give ample evidence of hard usage, and there is where a truck shows what it is made of—on a rural motor freight line in Colorado, for the roads are sometimes rough, the curves sharp and the grades steep.

An Acme truck is engaged in intercity haulage between Detroit and Imlay City, Mich. This truck is operated by the Detroit & Imlay City Truck & Cartage Co. It hauls milk to a Detroit creamery and takes freight and express on the return trip, making about 200 miles per day.

An Acme truck is also in daily use between Detroit and New Hudson, a distance of 50 miles. This truck also brings milk and cream in and takes freight and express return loads.



ACME TRUCKS IN INTERCITY HAULAGE SERVICE IN COLORADO.

Hauling 96 ft. Smoke Stack from Denver to Greeley, a Distance of 55 Miles.—Hauling 5,000 lb. Soda Fountain from Denver to Loveland, 60 Miles.—Load of Mixed Groceries going from Denver to Greeley. This Truck Makes this Trip Six Times Each Week. —Same Truck on Return Trip to Denver from Greeley, Hauling 17 Live Sheep.

Another FEDERAL

Federal Truck operated by the Sewer Department of the city of Cambridge, Mass.

"Return loads will cut your costs."

"Federal Has Done Most Excellent Work"

—says the City Engineer of Cambridge, Massachusetts, Mr. L. M. Hastings.

"The truck has been at work since last October, and has done most excellent work," he writes.

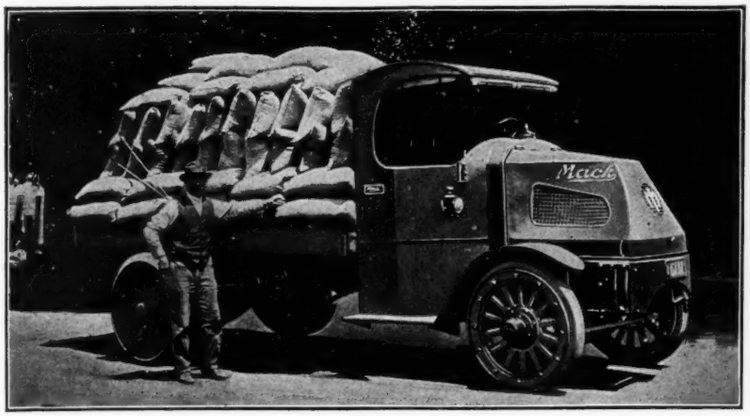
This is only one of the many instances where Federerals are proving most satisfactory in municipal work. Federal stamina—ruggedness—and a definite and easily figured economy, enable it to show a great superiority in all work where accurate costs are kept.

Write us and we will send you regularly the magazine *"Traffic News"*—a monthly magazine for truck owners and buyers.

Federal Motor Truck Company
35 Federal St. Detroit Mich.

FEDERAL

One to Seven Ton Capacities



MACK 3½-TON TRUCK HAULING BAGS OF WHEAT FOR JAMES McCAFFERY, OF SPRAGUE, WASH.

Performance of a G. M. C. Truck

Herewith is shown an illustration of a G. M. C. truck in use for hauling ore out in the mountain district. The owner of this truck states that for four months following the purchase of the truck he used it day and night on an ore haul.

This is a two ton truck and the owner states that his average load was about 7,600 lbs. The haul was 8 miles long each way and he averaged 7 round trips in 24 hours over roads that were very much cut up and extremely rocky, and in addition, the ore had to be unloaded by hand for the reason that he did not use a self-dump body.

What Mack Trucks Are Doing in Intercity Haulage

In view of the rapid extension of truck haulage in intercity traffic, the outlook for motor trucks after the war is most promising. There are examples now where motor trucks are handling short-haul freight 24 times as fast as the railroads at one-quarter the cost. Trucks not only equal railroad performance, but far surpass it. Between New York and Akron, Mack trucks chop 48 hours from the running time of the fastest railroad freight. They average the 533-mile trip in 60 hours.

The great future development in truck transportation will not be confined to the East alone, where the population is densest, but will extend into districts where the proportion of population to distance from supplies makes motor haulage a vital necessity. The town of Sonora, in West Texas, is a modern town of 1,000 people, seventy miles from the railroad. Brick buildings with modern improvements are prevalent, and all transportation from the railroad is by motor trucks. The water supply and sewer system were built of pipe brought seventy miles. The machinery for generating electric current was brought overland, as were also the wiring and many other accessories—all of these in motor trucks. A continuous truck service to the railroad is maintained by a number of Sonora stores. Furthermore, all of this trucking is over rather mediocre roads.

Schacht Trucks in Inter-city Haulage Service

The Middle-States Transportation Co., of New York City, operates a 3½-ton Schacht truck daily between New York City, Newark, N. J., and Philadelphia. The Middle-States Transportation Co. maintains a warehouse at each of these points. Local trucks collect the freight and bring it to these warehouses at which point it is loaded onto the large trucks which provide through service between the points mentioned.

G. M. C. 2-TON TRUCK HAULING ORE IN MOUNTAIN DISTRICT. AVERAGE LOAD 7,600 LBS. HAUL 8 MILES EACH WAY. SEVEN ROUND TRIPS IN 24 HOURS. UNLOADED BY HAND.

Joseph Seidl of New York City has a 3½-ton Schacht truck

FEDERAL 5½-TON TRUCK EQUIPPED BY MONTANA COUNTY ENGINEERS TO KEEP THE ROADS OPEN THROUGH WINTER STORMS.

Never before has the need of motor truck dependability and adaptability become so apparent in contracting and municipal and county engineering work as today.

Kissel, realizing this, has incorporated in the vital structural parts of Kissel Trucks those engineering principles and construction features which ten years of motor truck designing and constructing experience, to meet contractors' requirements, have proven to produce unlimited power, ability for continuous service, and low operating cost and upkeep.

The ALL-YEAR Cab, an exclusive Kissel Truck feature, ***insures uninterrupted performance, no matter how severe the weather may be.*** In summer it is an open, cool cab; in winter it is completely enclosed, increasing the driver's efficiency by giving him complete protection.

There is the right size truck for every contractor's requirements. See your nearest Kissel Dealer, who has specifications, prices, etc.

SEE HIM WITHOUT DELAY.

KISSEL MOTOR CAR COMPANY, Hartford, Wis., U.S.A.

KISSEL TRUCKS

DENBY TRUCK AS OPERATED BY THE WILLOWMOOR FARMS IN STATE OF WASHINGTON, IN TRANSPORTING FARM PRODUCTS TO VARIOUS MARKETS.

which is used only for long distance hauling, making frequent trips to Buffalo, N. Y., and Boston, Mass. This concern, however, does not maintain a regular schedule like the Middle-States Transportation Co., even though practically all of their hauling is devoted to long distance trips, including the cities of Buffalo, Baltimore, Philadelphia, and even Pittsburgh.

Experience of Stedman Bent in Inter-city Haulage

Stedman Bent, Franklin Trust Bldg., Philadelphia, was among the pioneers in the inter-city motor haulage of freight. In the following letter to the editor his experience in this line is summarized:

"We do not engage in what is ordinarily known as 'express' business. We confine ourselves to what is termed heavy hauling, and none of our trucks are equipped for carrying express matter. They are ordinary platform body trucks with stakes about 5 ft. high, and when the load is of a perishable nature, it is covered with large water-proof tarpaulins. Our business is principally hauling individual loads from one point, originating generally in Philadelphia, to any other point that our customer desires the material to be hauled, and consists generally of individual loads and not mixed ones.

"We are equipped to handle any kind of material. We have Power Winch trucks to load and unload heavy machinery; we have trailers of 5-ton capacity (the same as our trucks) whereby we can handle double loads if necessary, or long pieces which would require a long unit. We have hauled from Philadelphia to Pittsburgh, Boston, Richmond, Va., and all intermediate points; in fact, covering the radius of the cities above named, I do not think that there is any particular city of importance included that we have not touched some time or another. We have hauled coal to Washington, turkish rugs to New York, tin cans to Hartford, Conn., bedding machinery from Boston to Philadelphia, and we have hauled heavy contractors' equipment all over the country, where speed was essential, and have been generally successful in doing so.

"Our experience in inter-city hauling has been generally a very pleasant one with the exception of last winter, which everyone knows was exceptionally hard, and of course, we had considerable trouble on account of the weather. We do not hire anyone but experienced drivers for our long distance work, and, where possible, for any city work that we have to do. The roads are in fairly passable condition at the present time, but are rapidly becoming worse, as practically no road repairing is being doing along the main highways as far as we can learn. We, with our 50 trucks, have been able to relieve railroad congestion considerably, we think, and in that way have done our duty towards the country."

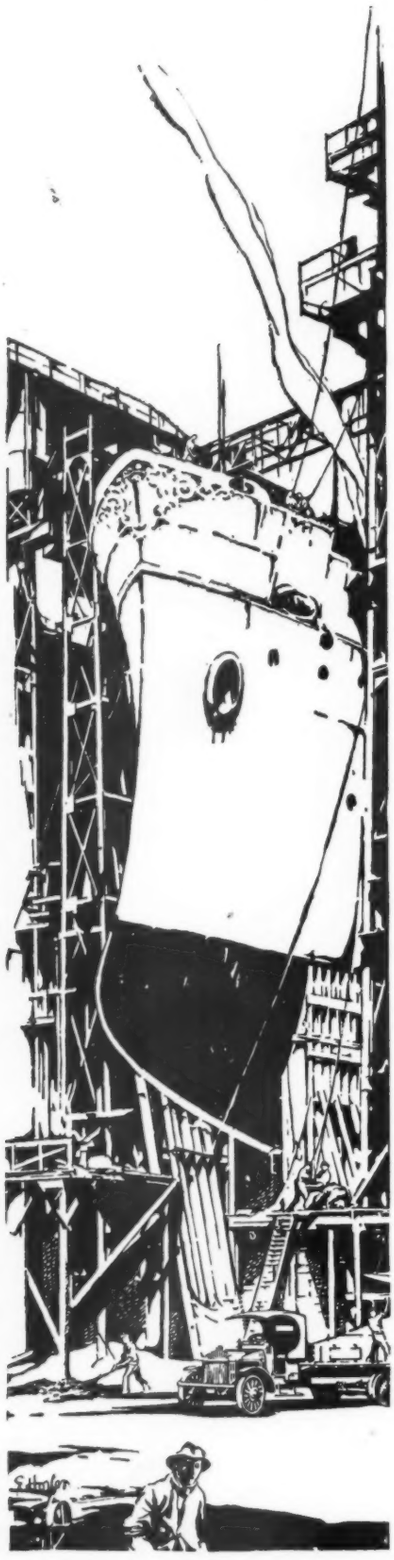
U. S. Bureau of Markets Seeks to Develop Motor-Truck Routes

The Bureau of Markets of the United States Department of Agriculture has announced its readiness to enter into co-operative agreement with operators of rural motor-truck routes who desire to work more closely with the government in developing, stabilizing and standardizing this business. Operators who agree to work according to most approved practices, and to conform to the general requirements of the Bureau of Markets are to be given the advantage of receipt of advice and information developed through the bureau investigations.

Large metal signs for display on trucks will be furnished

FEDERAL 3½-TON TRUCK RELIEVING FUEL SHORTAGE BY HAULING WOOD 100 MILES OVER CALIFORNIA MOUNTAIN ROADS TO THE RAILROAD.

Building fleets for the Nation's shipping



Pierce-Arrows have played a large part in the war activities of the Nation—on the front in France and behind the front with the Expeditionary Force. And they have had an important part in war work over here.

The vital task of building ships to transport men, munitions and materials has employed them widely. The fleet of 21 Pierce-Arrows owned by the **Watson Construction Company** has helped signally in the building of the new ship yards at Hog Island, Pa., and on Newark Bay, as well as in navy work in New York and Boston. There has been no more important war work to do over here than speeding up ship construction.

At the various munition plants, Pierce-Arrows have done their bit and at all the Army Camps, both in building cantonments and in carrying materials after the construction work was finished.

Reliability has been prime factor—and the ability to deliver a greater aggregate load in the least time. In this no truck shows so well as

PIERCE-ARROW
Motor Trucks

Fleets of Pierce-Arrows attain maximum efficiency

Building fleets for the Nation's business

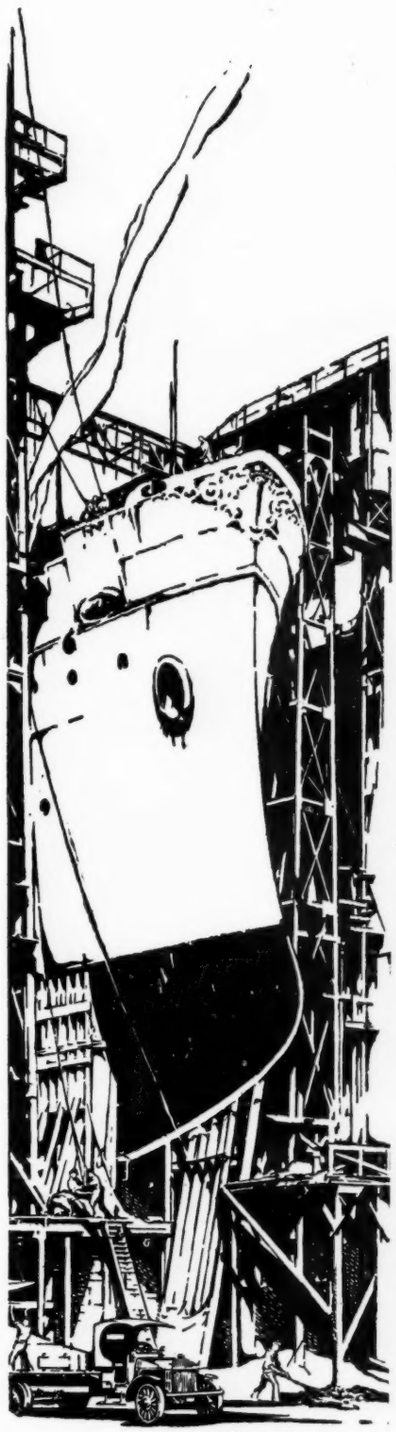
Pierce-Arrows are playing their part in the business upbuilding of the Nation. In avoiding intolerable delays due to freight congestion their contribution has been important. In keeping open avenues of trade they help speed up production and provide the sinews of war for the military body.

In construction work incident to business maintenance their success has been tremendous. In this line, **the Watson fleet** has had many notable achievements, that emphasized uninterrupted service and the ability to deliver a greater aggregate of work in a given time than other trucks.

This capacity was demonstrated in building the Brighton Beach Speedway. There 8 Pierce-Arrows worked with three shifts of drivers 24 hours a day, hauling material from tidewater docks 6 miles away and averaging 125 miles a day.

Again on a road filling contract at Unionport, N. Y., they handled material that ordinarily would have required a temporary railroad and hauling locomotives. Their cost was one-quarter the alternative cost.

In saving, conserving, speeding up work, no truck has made so good a record as



PIERCE-ARROW
Motor Trucks

The Pierce-Arrow Motor Car Company, Buffalo, N.Y.

"Just Look at that Duplex Climb"

Duplex 4-Wheel Drive Trucks are consistent performers.

Always can they be relied upon because there is built into them reserve strength and reserve power—more than is needed even under most severe service.

Duplex Trucks are dependable because all four wheels work.

The front wheels are not obstructive—they do more than carry the front end of the truck—they help drive.

Equal distribution of motor power to all four wheels makes Duplex Trucks reliable throughout the year.

Snow and blizzards never prevent the operation of Duplex Trucks—never make it necessary to put Duplex Trucks in storage.

They haul capacity loads when other types of trucks are laid up during severe winter weather.

DUPLEX TRUCK COMPANY
2050 Washington Ave. Lansing, Mich.

With tire mileage greater—
And fuel consumption less—
Duplex cost per ton-mile is always lower.

DUPLEX FOUR WHEEL DRIVE TRUCK

to operators meeting the requirements. These signs will read, "The Owner of This Truck is Co-operating with the Bureau of Markets, United States Department of Agriculture." The operator also will be privileged to use this sentence on his stationery and in advertising.

Requests for application blanks, to be used in obtaining the signs, should be made to the Chief of the Bureau of Markets, United States Department of Agriculture, Washington, D. C.

Through its co-operation with motor-truck operators the Bureau of Markets hopes to make it easy to place in proper hands such advice and information as it may secure; to act as a medium for distribution of information among operators; to stabilize the rural motor business by requiring adherence to certain business practices, and to give to reliable operators the business advantage of working co-operatively with the Bureau of Markets.

Truck operators who desire to co-operate with the bureau must agree to maintain dependable service and schedules; charge just rates based on cost plus a reasonable profit; keep satisfactory records of operating costs and furnish certain of them to the bureau; use uniform bills of lading approved by the bureau, and provide adequate insurance for shipments.

No attempt to exercise arbitrary authority or to insist on practices detrimental to proper and profitable conduct of motor-truck routes will be made, says the announcement of the bureau.

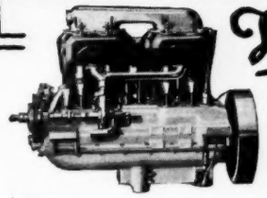
Truck Trip Shows Value of Good Roads

A 238-mile trip made by a 2-ton Federal truck shows the value of good roads. The truck made 16.4 miles per hour on concrete roads, 9.5 on gravel and 4.6 on dirt. On a 96-mile trip 18 hours would actually be saved if all the roadway were concrete as over the best time on dirt roads. At $2 per hour this is worth $36 per trip.

Good Driver is Important in Inter-city Haulage

Well paid, high grade motor truck drivers, whose compensation is paid by the hour, and not by the day, will bring success to any motor truck hauling business, in the opinion of Forrest J. Alvin, general manager of the United States Motor Truck Company. Mr. Alvin finds that the high-grade driver, well remunerated for his labor, and paid by the hour, allowing of no waste time to complete some important work within the strict hours of his working day, is an asset and not a liability. Returns from such a driver always yield a profit. When a driver is paid by the day, and there is not sufficient time remaining for that day to complete a job, hours will be lost, whereas payment on the other plan will cause the driver to complete his job regardless of overtime.

Plenty of Reserve Power for the Hard Steady Plugging of Municipal Trucking in all trucks equipped with

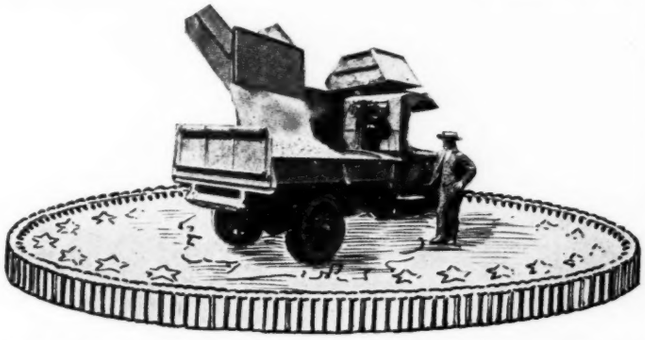


Wisconsin CONSISTENT **Motors**

Write For specifications of different types and sizes.

WISCONSIN MOTOR MFG. CO.

Station A. Dept. 330. MILWAUKEE. WIS.



SAVES MUCH MORE THAN IT COSTS

The Savannah Construction Co., Savannah, Ill., writes: "Our two Heltzels saved us $4.50 *per day*, and in addition we cut our loading time by fully 20 per cent. Loads dumps clean in 10 seconds. That's why we say there is no comparison between Heltzel's and hand loading."

Write for facts and figures of Heltzel performance on some of the biggest jobs in the country.

Heltzel Steel Form & Iron Co.

WARREN, OHIO.

SCHACHT

WORM DRIVE TRUCKS

"Equal to Any Occasion"

Be a Schacht Distributor

The Schacht line of quality trucks offer unusual selling posibilities to live dealers. Two to five ton at the right price for immediate delivery.

Sell a truck that will give ultimate satisfaction and be sure of reorders.

Trucks are moving the equivalent of over 500,000 carloads of freight yearly at this time, and trucks are only in their infancy of appreciation and use.

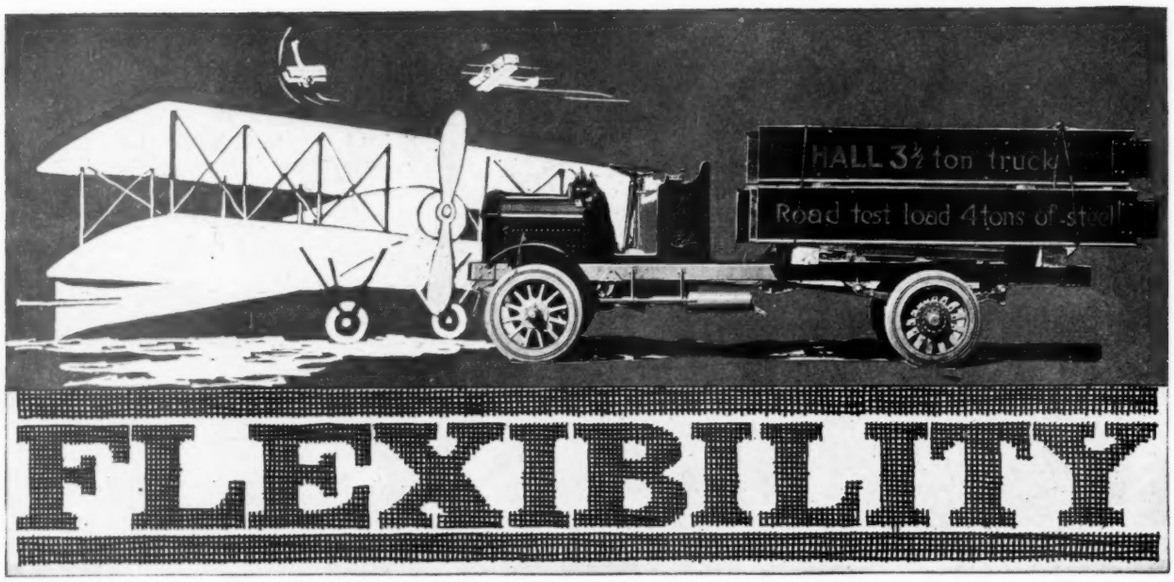
Wire today.

2 Ton Model . $3,150.00 F.O.B. Factory
2½ Ton Model . $3,500.00 F.O.B. Factory
3½ Ton Model . $3,950.00 F.O.B. Factory
5 Ton Model . $4,950.00 F.O.B. Factory

The G. A. Schacht Motor Truck Co.

Factory and Main Office: CINCINNATI, OHIO

New York Branch: 422 E. 54th Street
Chicago Branch: 2021 Michigan Avenue



FLEXIBILITY

Flexibility! ***Another word for smooth going!***
In HALL Trucks it's equivalent to *coasting.*

The Heaviest loads! The roughest roads!
HALL solves them ALL!

Sandy road hindrance — steep hill delays — *full-capacity, all-day* hauling difficulties—these all gently yield to the *perfect, powerful mechanism* of the famous HALL engine!! (Backed by fifteen years of master engine building.)

Standardized by Continental Motors, Timken Axles and Bearings, Brown-Lipe Transmission and other nationally-known parts. That's why the HALL adjusts itself to any kind of traffic and hauls without a *whimper* in most *strenuous service!*

"Haul in a HALL!"

Read the specifications and performance records that make this Truck the most profitable for you to *own!*

THE LEWIS-HALL IRON WORKS
Manufacturers of the HALL Truck
(Established 1873)
Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

New York Distributors: Robert D. King & Co., Inc., 221 W. 64th St., New York City, Metropolitan Dealers.
New England Distributors: Hall Motor Truck Co. of N. E., 1123 Commonwealth Ave., Boston, Mass.
Guarantee Automobile Exchange, 629-31 N. Broad St., Philadelphia, Pa., Philadelphia Dealers.

EDITORIALS

Will Illinois Prepare For Peace?

Thoughtful people, the nation over, are awaiting with keen interest the vote at the general election in November when the people of Illinois will decide for or against the issuance of $60,000,000 of bonds to pay for a state-wide system of durable, hard-surfaced roadways upon the public highways of the state, comprising 46 intercity routes. This bond issue provides a test of the intelligence of the people of the state and it is, therefore, of national significance. If the issue is approved it will indicate that the voters are capable of looking into the near future; if it fails it will demonstrate conclusively that they cannot see past the ends of their nasal organs. The vote will test the ability and willingness of the people to prepare for the return of peace. The proposition has the endorsement of the governor as distinctly a preparation-for-peace measure. Until the close of the war bonds will not be sold and construction will not begin. When peace does come, as it must come, the great construction program will be ready to launch if the people vote "yes" now.

Incidentally, this bond election provides an opportunity for the average citizen to secure something for nothing, which was ever the dearest wish of the well known human heart. No one will dispute that the comprehensive system of highways contemplated will be beneficial to every citizen of the state and these good roads are to be had by the average citizen without the expenditure of so much as one cent. The average citizen does not own an automobile and these roads are to be paid for exclusively with money received in the form of state automobile license fees; both principal and interest on the bonds will be paid in this way. Taxes will not be increased. The automobile owners are not only willing, but are anxious to stand the expense.

Over $30,000,000 of the $60,000,000 will go to laborers. This points the way to adequate preparation in Illinois for the return of peace. Illinois believes in preparedness for war; does she believe in preparedness for peace? The people must decide at the polls.

"Nothing Else Counts"

Across the letterhead of a correspondent this slogan is printed: "Our Business is to Win the War—Nothing Else Counts."

Slogans must be brief to be effective, and it would be unfair to read into them a meaning they neither express nor imply, but the slogan here quoted is at least half bad. That the first and most important business of this country is to win the war will not be disputed by any patriot, but the idea that nothing else counts is merely the present day manifestation of the national tendency to ignore the future. Some say the greatest danger now confronting this country is a feeling of overconfidence about the early and favorable termination of the war, but it seems an even greater danger lies in the tacit assumption that we need only win the war and everything else will take care of itself thereafter and be perfectly lovely for evermore.

When the soldiers and sailors return to their homes at the end of the war and have received our homage they are going to ask what we have been doing while they were away. Let us think now of the answer we shall make. It is the function of the soldier to end the war but it is our function to prepare for the peace that shall follow. It is said the soldiers are wondering how their efforts are regarded by the folks back home. This does credit to their modesty but it should not mislead us. What we think of them is best expressed by the sacrifices we now make to support them and by the plans we now make for the period immediately following the war. Rooting from the side-lines is natural and easy; saving food is a bit difficult to the individual but undoubtedly benefits his health; buying bonds leaves a pleasant patriotic glow, but is essentially the best investment in the world—we must do more than these things. We must do a very difficult thing; we must plan for the future. In this land of chronic unpreparedness that is indeed difficult.

In the municipal and county field it should be easy to prepare for peace. The needful thing is to have plans ready so that as soon as our own government takes down the bars, construction work can begin. It would seem that city officials would be planning improvements now for construction after the war. Are they? Some are, many are not. In these columns two months ago we published an editorial entitled, "How Are the Plans Progressing?" It was urged that cities utilize the present lull by planning future improvements. Judging by the number of requests we have had for reprints of that editorial, many cities are taking absolutely no thought of the future.

City officials should have a care that the day of glory on which the soldiers return is not followed by a day of wrath when the soldiers learn that nothing more substantial than a flimsy reviewing stand has been planned in anticipation of their return.

Unwisdom of Restricting Road Construction Well Illustrated in Pennsylvania

When conditions in Pennsylvania are considered the opposition to road construction almost reaches the proportions of hostility. Never was the need for good roads more clearly indicated than in that wealthy and populous state, yet we find applied there the same restrictions imposed in states of relatively small wealth and sparse population.

Unless the United States Highway Council recedes from the stand first taken, road construction in Pennsylvania will practically cease until after the war. There are 64 roads now under construction. The Council has disapproved, or taken no final action, on all except 9 of these roads. This means that work on these roads must cease as materials cannot be ob-

tained for roads disapproved by the Council. That these are important roads may fairly be inferred from the fact that local authorities are paying one-half the cost of the improvements.

In a press release, issued by the State Highway Department, the statement is made that the department is of the opinion that the U. S. Highways Council has failed to realize the importance of road work in Pennsylvania and the great hardship that will be imposed upon the local communities by leaving the roads in an unfinished condition. While nothing may come from their courageous devotion to duty, the State Highway Department is entitled to all praise for making a defense of the cause of improved roads during the present emergency. Just how important these roads are may be gathered from the following quotation from the release mentioned:

> No one can question the willingness of Pennsylvania to co-operate with the Washington authorities. Pennsylvania is doing her full share, and will continue to do so, but good roads are not only essential and necessary as a war measure, but they are a vital economic necessity, particularly in a great industrial, manufacturing and mining state like Pennsylvania. This was demonstrated last winter when many of the large industries of the state were seriously handicapped, only being able to operate by reason of their ability to transport their coal from the mines, and various other supplies, over the highways of our state, in trucks. Manufacturers and other wholesale dealers in Pittsburgh, Philadelphia and other large centers now deliver their merchandise by trucks over the highways within a radius of 40 and 50 miles. A great majority of all the army trucks pass through Pennsylvania.

Last winter a continuous stream of army trucks, loaded with munitions and supplies passed through Pennsylvania to the seaboard. These trucks and supplies are now being used on the battlefields of France. Nearly $2,500,000 has been spent by the State Highway Department during the past six months in rebuilding and repairing roads used by army trucks and by manufacturers engaged in war work. If roads like these are not essential in war times, the U. S. Highways Council might just as well say, first as last, that there isn't any such thing as an essential road. This cannot be done, however, without flatly and categorically repudiating their policy as recently promulgated.

It is hoped, at the time of writing, that the Council will modify its Pennsylvania rulings to the extent at least of approving the projects now under construction for which a large percentage of the requisite material is actually on the ground.

It is not conceivable that any section of the business community would regard these roads as anything but essential in the highest degree. The fallacy that funds are lacking for road work has been exploded. Moreover, the Pennsylvania State Highway Department has made a study of the labor situation and is ready to present evidence that the greater percentage of the men on road construction are men unfit for army service or for work in munition factories.

In the light of these circumstances the statement of the Council that it hopes "to render active aid on the projects it approves" leaves one in doubt as to whether this statement is a threat or a promise.

The War and Money

When the war started, August, 1914, economists ridiculed the opinion advanced by military men that it might last for years. The economists were able to prove to their own satisfaction that the war could not last longer than six months for by that time the belligerent powers would all be bankrupt. Since then economists, financiers and bankers have learned something about money.

The American Bankers' Association recently held their annual convention. In his address Charles A. Hinsch, Cincinnati, O., president of the association, said that this country can raise $300,000,000,000 for the purpose of winning the war, if need be, and by the time that is used up can raise a few more billions for the same purpose. He said there is literally no limit to the amount of money that the United States can raise. Coming from a banker, these statements admit of no discount.

Last month it was pointed out here that the lack of money is not the thing that is stopping highway improvement work. Bankers admit that money for road improvements would be forthcoming if roads were pronounced essential. Let it be clearly understood there is no lack of money, present or prospective.

Influence of Engineers on Selection of Construction Equipment

A few years ago the publishers of engineering papers discovered the contractor. Since then some of their representatives have almost lost sight of the engineer. Feeling that the contractor is the man who buys the equipment which is advertised, and thus makes possible the existence of engineering papers, many of the solicitors have felt that the contractor is all-important as a subscriber.

Without for a moment disputing the soundness of some aspects of this opinion, it should at the same time be evident to every one that the engineer also exerts a tremendous influence on the selection of construction machinery and supplies. This influence takes different directions. In some cases where the construction is carried on by force account, the engineer has the entire say-so about the selection of the equipment. With reference to the materials, of course, the engineer's specifications usually determine directly or indirectly the choice of the materials. But it is to another aspect of the matter, so frequently overlooked, that special attention is called.

Whatever contractors may say about engineers and their grade stakes, their blueprints, their specifications, etc., the contractor has a wholesome and abiding respect for the engineer and frequently asks his advice when contemplating the purchase of construction machinery. This advice is not always asked for in so many words. It sometimes happens that the contractor attempts to solicit this information without asking for it directly, but he wants it just the same, and the obliging engineer gives it. It would be interesting to know just how many pieces of important construction machinery have been bought and paid for by contractors on the direct or indirect recommendation of the engineer. We feel that the percentage of equipment so selected is very high. Manufacturers, therefore, can make no greater mistake than to assume that the engineer subscriber is not quite as important as the contractor subscriber from the advertiser's standpoint.

PAVEMENT DESIGN AND CONSTRUCTION

Special Underdrainage Safeguards New Cleveland Pavement

By Fred R. Williams, Engineer of Paving, Cleveland, Ohio

Woodhill Road and East 93rd street in Cleveland, Ohio, is the most important cross-town thoroughfare in the southeast section of the city. In consequence it carries an immensely heavy traffic; passenger vehicles and commercial trucks make a steady stream in addition to street railway cars, which use a double track and operate on 3-minute headway.

Old Pavement Replaced

The street has been paved for several years, for the most part with vitrified brick laid on a sand cushion and 4-in. concrete base. The condition of this pavement made it necessary to replace it; the concrete in the old base was of poor quality; the sand cushion specified to be 2-in. deep was 4 ins. in many places; so great a depth of cushion could not be thoroughly compacted so that joints between the brick were filled with sand to the exclusion of the grout filler.

The subsoil is of heavy clay. For a considerable distance Woodhill Road lies along the edge of a cliff, and this location, combined with the impervious subsoil which made drainage difficult, contributed to the need of renewal.

The New Pavement

A new brick pavement is being built this season. The weight and volume of traffic made a substantial pavement imperative. The street is therefore being repaved with brick of two types; one section of 5-in. brick laid upon 7 ins. of green concrete, the other, 5-in. brick laid upon a 1-in. cement-sand bed and 6 ins. of concrete. In both sections there is, therefore, a solid pavement 12 ins. deep which we expect to be adequate for both present and future traffic.

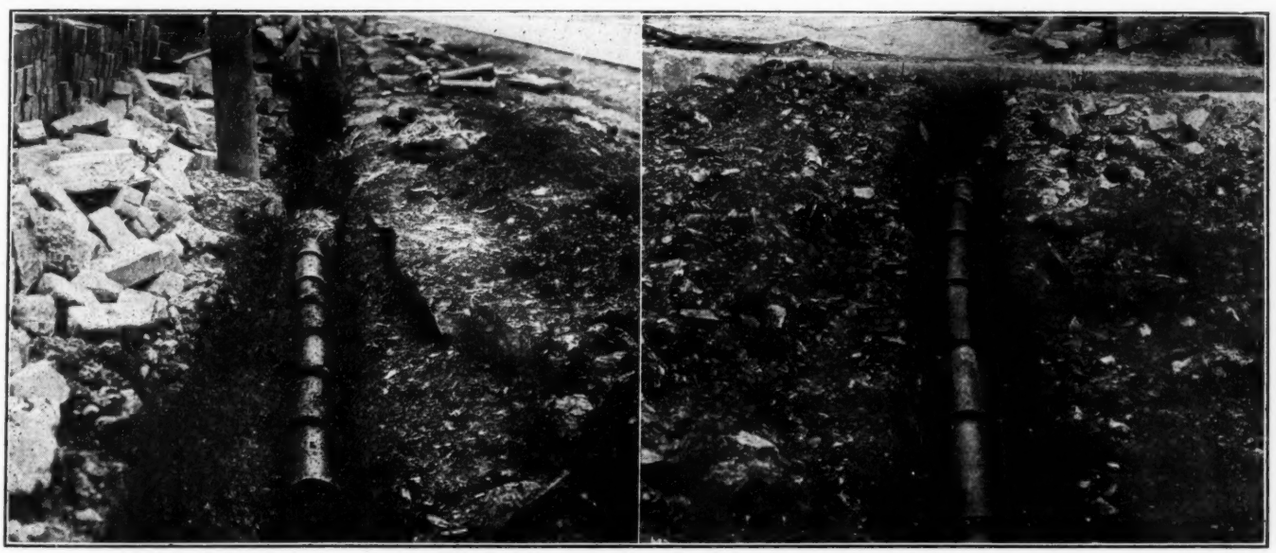
Special Underdrainage

Special underdrainage has been provided to safeguard the new pavement, as distinguished from the standard underdrainage requirements of the city of Cleveland, on the grounds that while the standard type is adequate for the majority of pavements in the city, any unusual requirements make amplification necessary.

For the past 2½ years no pavement has been built in Cleveland that did not have a line of 4-in. vitrified clay pipe of the ball and socket type 6 ins. below and outside the curb on either side of the street. In fact, on the west or down-hill side of Woodhill Road, the standard type of underdrainage was retained.

On the up-hill side, however, the size of curb pipe was increased to 6 ins., and 4-in. laterals laid 45 degrees to the curb were added every 50 ft.

The total width between curbs is 44 ft.; the double car tracks require 15 ft. in the center of the street so that the pavement on either side is 14½ ft. wide. Laterals were brought to within a few inches of the ends of the ties; at this point the tops of the laterals were 6 ins. below the base of the pavement. A fall of about 8 ins. was provided to quicken the discharge into the main 6-in. line back of the curb, which in turn discharged into 12-in. catch-basin connections.



VIEWS SHOWING SPECIAL UNDERDRAINAGE OF NEW BRICK PAVEMENT ON WOODHILL ROAD IN CLEVELAND, OHIO.

On Down-hill Side a 4-in. Vitrified Clay Pipe is Placed 6 Inches Below and Outside Curb. On Up-hill Side this Curb Pipe is 6-in. and Has 4-in. Laterals at 50-ft. Intervals Laid 45 Degrees with Curb.

Lateral trenches were backfilled with well-rammed cinders up to the base of the pavement; cinders also support the curb on either side, as well as covering the 6-in. main line with at least 12 ins.

At intersections, the end of the lateral next to the ties was buried deeper and a supplementary lateral was laid at right angles to discharge into the end of the diagonal lateral. The purpose is, of course, to clear water from all parts of the intersection, and it was found to be a feasible method.

War conditions made it impossible to secure burlap to cover the pipe joints; in the place of burlap, a thin layer of straw was laid over the pipe, and as far as can be determined, is quite satisfactory.

The Asphalt Roads of Cook County, Illinois

By Walter H. Flood, Chemical Engineer and Consulting Chemist, 22 Quincy St., Chicago, Ill.

Cook County has paved, with the money from its bond issue, five main roads with asphaltic concrete: Higgins and Rand Roads, Archer Avenue, 95th Street and 147th Street. Higgins Road extends from the city limits to Dundee, a stretch of over 25 miles. All of this is not completed but a large portion has been open to traffic for some time and the remainder is under construction. It will receive heavier traffic than any of the other roads as it is the only direct connecting link between the city and the large truck-farming district through which it runs.

Change from Macadam to Concrete Base

The first specifications for the asphalt roads constructed under the bond issue called for a 2-in. wearing surface on a macadam base and a portion of the paving was laid this way. Some of this has been down two years and shows up well with the exception of a few places which have become a little uneven due to settling of the base. It was afterward decided to put down future pavements with a concrete base, as the cost is but little higher than for macadam base and the results are more satisfactory.

Trinidad Asphalt Used

All types of asphalt are admitted under the specifications, but thus far only Trinidad has been used on the roads. The specifications for the asphalt cement or bituminous binder are essentially those of the Illinois State Highway Department and are classified into three groups to include oil, blown oil, and natural asphalts. There are no specifications for refined asphalt or flux. The following are the specifications covering Trinidad asphalt cement:

Specifications for Trinidad Asphalt Cement

The asphaltic binder shall be produced by the refinement or distillation of crude native bitumen of an asphaltic nature and the combination therewith of a fluxing oil, when the nature of the bitumen requires it, to produce the proper consistency for use in the pavement. The asphaltic cement may be delivered from the refinery at the proper consistency for use without the further addition of flux, or the refined solid asphalt may be delivered to the paving plant and there combined with the necessary amount of flux. The flux may be a paraffine, a semi-asphaltic or an asphaltic residuum suitable for the particular grade of asphalt used. The asphaltic cement proposed for use in the pavement must possess the properties hereinafter described and which has demonstrated that it retains these properties by having been in successful use in asphaltic concrete pavements.

Samples of the asphaltic cement, properly labeled with brand or trade name, must be furnished for analysis which will be made under the direction of the engineer by a reputable chemist experienced in the analysis of hydro-carbons, and according to the result of this analysis it will be determined whether the asphaltic cement offered complies with these specifications and is suitable for the purpose intended. The brand or grade of asphaltic cement on which contract is awarded shall be used in the construction of the pavement. Analysis also may be made as often as the engineer may desire of the asphaltic cement after the contract is awarded and after the work is begun, and if any of the analyses should fail to agree reasonably close with the analysis of the sample submitted with the bid, the lot in question will be rejected. Sufficient time shall be allowed for tests to be made before the asphaltic cement is needed for the work.

Inspection

The County Superintendent of Highways and inspectors of State Highway Department shall at all times have access for inspection to all branches of the work on the street, at the refineries, or at the plant where material is stored, prepared, or being mixed; and the contractor shall furnish from time to time such samples of each separate ingredient, or combinations of the materials to be used in the improvement as may be requested by the County Superintendent of Highways.

When deemed necessary by the County Superintendent of Highways, the contractor shall store separately and in such manner as to admit of identification any or all materials which he proposes to incorporate in this improvement.

Requirements for Bituminous Binder

When tested in accordance with the methods described in Bulletin 314, United States Department of Agriculture, the bituminous binder shall conform to all of the following requirements:

The bituminous binder shall be free from water.

Specific Gravity—The specific gravity at 25° C. (77° F.) shall not be less than unity.

Total Bitumen—The bituminous binder shall be soluble in chemically pure carbon disulphide at air temperature to the extent of at least 95 per cent for the Bermudex products, 80 per cent for Cuban products, and 65 per cent for Trinidad products.

Naphtha Insoluble Bitumen—Of the total bitumen not less than 15 nor more than 28 per cent by weight shall be insoluble in 86° B. paraffin naphtha at air temperature. On evaporation of the naphtha solution, the residue obtained shall be sticky and not greasy.

Fixed Carbon—The fixed carbon shall be not less than 6 nor more than 14 per cent.

Penetration—The penetration of the bituminous binder as determined with the Dow penetration machine, using a No. 2 needle, 100 grams weight, 5 second time, and a temperature of 25° C. (77° F.) shall be not less than 5 nor more than 8 millimeters.

Loss on Evaporation—When 20 grams (in a tin dish 2½ ins. in diameter and ¾ in. deep, with vertical sides) are maintained at a temperature of 163° C. (325° F.) for 5 hours in a N. Y. testing laboratory oven, the loss shall not exceed 6 per cent by weight. The surface of the residue at air temperature shall be smooth and show no sign of blistering or cracking.

Flash Test—The flash point by the open cup method shall not be less than 163° C. (325° F.).

Brittleness Test—A cylindrical prism of the bituminous binder 1 centimeter in diameter, after being maintained at a temperature of 5° C. for 20 minutes shall bend 180 degrees at any point without checking or breaking. The bending shall take place in one continuous operation requiring not more than 10 seconds.

Specifications for Wearing Surface

The specifications covering the wearing surface are:

The asphaltic concrete wearing surface shall consist of an asphaltic cement, sand, limestone and mineral dust, so proportioned that the mixture will contain average proportions by weight of the whole mixture, as follows:

Bitumen ..... 6½% to 8%

Mineral—

Passing	and Retained On		
200 mesh	... mesh	6% to 11%	
80 "	200 "	6% to 15%	
40 "	80 "	10% to 25%	
10 "	40 "	10% to 20%	
4 "	10 "	10% to 40%)	Total, 40%
2 "	4 "	5% to 20%)	to 55%

The items designated as passing 200 mesh sieve, include filler, fine sand passing a 200 mesh sieve, and such 200 mesh mineral as is naturally contained in asphaltic cement.

Reduction of Stone and Elimination of Seal Coat

On some of the roads first laid the mixture had almost the

maximum amount of stone specified, 55%, but it was found did not close up as much as was desired and had too open an appearance. This condition necessitated using a seal coat which was provided for in the first specifications. It was desirable to eliminate the seal coat, if possible, and the mixture was modified bringing the stone content down to near the lower limit, 40%. This gave a good close surface and required no seal coat which was eliminated from subsequent specifications, a cement swept finish being substituted. This 40 per cent stone mixture has shown very good results so far, and from all indications the roads laid with it should give excellent service.

Mixture Gradings

The following are a few of the mixture gradings:

	95th St.	Archer Ave.	147th St.	Higgins Rd.
Bitumen	7.9	7.1	7.1	7.0
Passing 200 mesh	8.7	10.3	9.1	9.9
" 80 "	15.1	8.3	8.7	8.8
" 40 "	19.7	18.8	15.4	16.5
" 10 "	7.0	14.6	13.5	18.7
" 4 "	18.3	25.1	20.8	16.3
" 2 "	23.3	15.8	25.4	23.8

At each asphalt plant the county places an inspector to control the mix. An inspector from the State Highway Department also visits the plant frequently, and samples of the mix and materials are sent regularly to the State Laboratory and to the writer's laboratory for analysis. Each car of asphalt and of flux is sampled and a complete analysis of the sample is made. All materials entering the work including the cement and stone in the base are inspected and tested before being used.

The roads have already received a large amount of traffic of all kinds, and while they have not been laid long enough to predict with certainty how long a life they will have, they have so far given no evidence of wear and their appearance would indicate many years of good service ahead which will fill a long-felt want in Cook County.

The Use of Modern Machinery in County Road Construction

By C. B. Scott, Assistant State Highway Commissioner, Richmond, Virginia

The question of the use of modern equipment in county road construction is a subject of great importance, particularly at this time when labor and material are both high in price and difficult to obtain. It is a subject which has so many ramifications that a volume might easily be written without exhausting it, said Mr. Scott in his address on August 7th, to the North Carolina Good Roads Association.

We, in the South Atlantic States, have heretofore had a comparative abundance of cheap labor and have therefore been prone to use labor where it would sometimes have been more economical to have used machinery. Now conditions have changed and labor is costly, and often cannot be secured at a reasonable price. As is always the case when the demand for labor is greater than the supply it becomes less efficient and more irregular, thus adding to both the cost and delays in the execution of work.

In a discussion of this nature it will be impracticable to give more than a brief description of the various modern machines and devices which are being used so advantageously in road construction, and point out some of the new ways in which they are being used.

For clearing right-of-way stump pullers are usually more economical than explosives and should be used when time will admit.

Slip Scraper Performance

Drag, or slip scrapers are made in the following sizes: No. 1, of 7 cu. ft. capacity; No. 2, of 5 cu. ft. capacity, and No. 3, of 3½ cu. ft. capacity. From 4 to 10 drag scrapers should be used to constitute a force, depending upon the length of haul. They are very efficient up to a haul of 100 ft. and can be used with economy up to 200 ft. Except when the material is soft it should be loosened by a plow or other suitable means.

A two-horse team and scraper can move the following amounts of loose material in a working day of ten hours, on the average:

For a haul of 25 ft., 70 cu. yds.
For a haul of 50 ft., 60 cu. yds.
For a haul of 100 ft., 50 cu. yds.
For a haul of 150 ft., 40 cu. yds.
For a haul of 200 ft., 35 cu. yds.

Wheel Scrapers

For hauls of from 200 ft. to 800 ft. wheel scrapers are efficient. They are made in four sizes: No. 1, of 10 cu. ft. and No. 3 of 17 cu. ft. capacity; No. 2½ of 15 cu. ft. capacity and No. 3 of 17 cu. ft. capacity. A snatch team is used for loading No. 2 wheelers, except in very soft material, and in almost all cases for loading No. 3 wheelers. They should be worked in gangs of from 4 to 6 for hauls up to 400 ft., and the number increased with the length of haul.

In a working day of 10 hours a two-horse team and scraper can move, on the average, the following amounts of loose material:

For a haul of 100 ft., 60 cu. yds.
For a haul of 200 ft., 50 cu. yds.
For a haul of 300 ft., 40 cu. yds.
For a haul of 400 ft., 30 cu. yds.

Neither drag nor wheel scrapers will carry loads equal to their rated capacity, and in rough materials the loads are often considerably reduced. In the construction of embankments with scrapers the embankments are compacted to such an extent that there is little future settlement, which is of considerable advantage where a pavement is soon to be laid.

Of recent years the Maney four-wheel scraper has come into use. It has the advantage of carrying a load from 1 to 1½ cu. yds., and can be used economically for hauls from 200 ft. to 2,000 ft. A tractor or hoist is best for loading, but a snatch team can be used for that purpose.

Road Graders

Road machines, or graders, are made in many styles and weights. The light two-wheel style is used largely for very light grading and shaping. A very heavy four-wheel machine is being used in this section for quite heavy grading and bids fair to be a great labor saver. In the construction of broken stone and gravel roads a road machine can often be used for shaping the roadbed and for spreading the stone or gravel, thus considerably reducing the amount of labor used.

Elevating graders, which have been successfully used in excavating irrigation canals in the western states, may be found suitable for road construction under some conditions. They are made in three sizes—large, standard and small—and require from 10 to 16 horses for motive power, or a tractor of equal power.

Trench Excavators

Trench excavators may find a place in road construction where it is necessary to construct a considerable amount of drainage ditches, particularly when the work is done in cooperation with adjacent property owners. The continuous bucket or wheel type of excavator is probably best adapted to work of this character. These machines are made in several styles and sizes.

Steam Shovels

Steam shovels of the revolving and sliding beam type are

adapted to grading and in heavy work should prove decidedly economical. In stone quarries they may be used to advantage in loading stone into cars for crushing, or, where it is necessary to store large quantities of stone in piles, for reloading it.

Industrial Railway Equipment

Narrow-gage locomotives and cars can be used economically more often than is generally supposed, particularly in hauling stone, gravel, sand, etc., for broken stone roads of bituminous or cement concrete construction.

Dump and spreading wagons are very useful and great labor savers, where the length of haul is not too great. The various types are too numerous to mention, though the essential features are practically the same.

Motor Trucks and Trailers

Motor trucks and trailers are rapidly coming into use and are proving satisfactory. For construction purposes somewhat larger trucks are generally preferred than where they are to be used for maintenance. It is usually best to purchase trucks of the same make, where a number are required, to facilitate the interchange of repair parts, and, where only a few are purchased, it is well to select a make which maintains a service station in the vicinity. When desirable, a truck can be advantageously used for pulling a plow, road machine or bituminous distributor.

Tractors

Tractors are superseding teams to a considerable extent for plowing, road machine work, hauling bituminous distributors, etc. They can also be used for operating a stone crusher for repair work, if equipped with a belt wheel, when not used for traction, and have the advantage of costing very little when not in use.

Drills

Standard steam drills are almost essential for quarrying stone or excavating considerable quantities of it in the roadway. Air drills of the hand type are useful in breaking large stones in quarries and for drilling rock in side ditches and for light rock excavation where they must be moved frequently.

Stone Crushers

Stone crushers may be considered a necessity for the construction of broken stone roads, and it has been quite a revelation to many of us to learn that they were being so seldom used by the European nations in the construction and repair of military highways. For construction purposes the 10x20-in. size will generally be found most serviceable and there are several makes which are very satisfactory.

Hoists

Hoists, with cable and cars, for transporting stone from quarries to crushers, and for similar purposes, will usually be found much more economical than wheelbarrows or carts. Frequently such a hoist can be operated by an additional wheel on the shaft of the crusher engine.

Sprinklers

Sprinklers for watering macadam and similar roads are very useful. They should be of the cut-under type to permit turning in a small space, and about 400-gal. capacity will generally be found most convenient. Where water from streams is to be pumped directly into the tank it is best to have spraying devices so arranged as to permit passage of the fine sand and small twigs and leaves, otherwise much time is lost in cleaning the sprayers and the caps become battered and worn in handling.

Scarifiers

Scarifiers are great savers of labor in the reconstruction of broken stone and gravel roads. Several satisfactory types are made and rollers are being made with scarifiers attached to the rear. The latter machines have the advantage of doing very uniform work and can be set to any depth desired, but will not operate up very steep grades for lack of sufficient power.

Rollers

Rollers for compacting the embankments and rolling the sub-grade and surfacing material are a standard part of road equipment and have been developed into very satisfactory and efficient machines. The three-wheel type of 10 to 12 tons weight is usually preferred. They are propelled by steam or gasoline, as may be preferred.

Bituminous Distributors

Bituminous distributors, either horse-drawn or motor-driven, are more economical and satisfactory for applying bituminous material than hand work, where a considerable amount of material is to be used. For horse-drawn vehicles about 600 gals. capacity is convenient and such machines should be equipped with heater and pump. Motor-driven vehicles are more elaborate in design and equipment, depending upon the use and amount of work to be done.

Concrete Mixers

Concrete mixers of small size are very useful for constructing end-walls for drain-pipes, culverts and small bridges. Larger mixers are convenient and economical for use in building large bridges, retaining walls, and in laying concrete pavement. The size and type desirable depends upon the purpose to which it is to be put.

Stone Bins, Elevators and Screens

Stone bins, with elevators and screens for separating stone and gravel according to size, and storing it temporarily, are very useful and the portable type usually is most economical. About 30 tons capacity, depending upon the size of the crusher, is usually most convenient.

Unloaders

Unloaders, operated by motor power, for loading materials from bottom dump cars into wagons and trucks, have been developed into very useful and economical machines, where a considerable quantity of material is to be handled. Another machine of a similar type is used for loading stone from piles. For unloading open top cars into wagons and trucks, car or skip loaders are great savers of time and labor. The 1½-cu. yd. capacity is generally to be preferred. This device is attached to the outside of the car and when loaded is dumped into the wagon or truck.

A public official, who accepts responsibility for the expenditure of money and labor, is in duty bound to make every effort to use the means placed at his disposal in the most efficient manner. He should be mindful of the fact that prison labor is the equivalent of money and he should not waste it, or permit it to be wasted by local road officials, where he has control of it. When work is done jointly by the state and counties it is sometimes the case that local officials are inclined to use prison labor too freely to avoid the expenditure of local funds for the purchase of proper equipment.

Under the discipline of a world war we are learning that waste and inefficiency are crimes, which are paid for in agony and death, and no one who has the welfare of our country at heart can be unmindful of his duty to utilize the means at his command to the best of his ability.

Overcoming the Heaving of Creosoted Wood Block Pavements

The swelling and subsequent heaving of creosoted wood block pavements can be practically overcome by placing the paving blocks directly on a concrete base painted with a bituminous coat. The condition of the various pavements, so constructed, which have been in service from two to seven years in middle western cities justifies this conclusion.

Paving blocks laid in this way, and properly spaced, with bituminous filler, have a waterproof coat on five of their six surfaces. This provides a degree of imperviousness which safeguards the blocks from the swelling resulting from water absorption.

The development in paving engineering here discussed is of prime importance, as the swelling and resulting heaving of wood block construction have been the inherent defects of that class of constructing. These are the defects usually advanced in arguments against the use of cresoted wood block pavements. The type of construction here described also eliminates the disturbance of the surface of the finished pavement caused by the shifting of the sand-cushion or by the improper preparation of the mortar-bed.

The Practice Not New Abroad

This practice of laying cresoted wood blocks immediately on a properly finished concrete base has been used abroad for many years both with and without a bituminous coating on the base, however, because of the difficulty of securing a smooth surface on the concrete base it was until recently considered impracticable in this country to lay blocks in this manner. Recent developments in the finishing of concrete pavements and concrete pavement bases have finally overcome this objection. Smooth surfaces on concrete bases are now readily obtained.

The method under discussion was first used in this country some seven years ago in a small city and subsequently by certain large cities including Chicago, Pittsburgh and St. Louis.

The City of Detroit is extensively using the bituminous coating cushion with good results. During the present year this method was also employed successfully in Milwaukee and Cleveland. Last year Toledo used this method in constructing 25,000 sq. yds. of paving, much of which is for paving in car tracks.

Procedure in Applying the Method at Toledo, Ohio

In the Toledo work mentioned, the concrete foundation was brought to a smooth surface and floated with a light concrete roller. This is the familiar roller method of finishing a concrete surface and is effective as the roller compresses the concrete and so squeezes out the excess water, producing a smooth surfaced base of uniform and high density. The base was allowed to set for five days and the surface was then given a paint coat of cold pitch (of a melting point of approximately 140 degrees Fahrenheit). This coat was poured on the foundation and spread with a squeegee. As soon as the pitch hardened the blocks were placed directly on it and the joints filled with pitch to within 1 in. of the surface. The filler was very hot while being spread over the blocks by means of the squeegee; this high temperature reduced to a minimum the quantity remaining on the upper surface of of the blocks. It is permissible to fill the joints completely at the first application for when the pitch cools about 1 in. of space will be left in the top of the joints. These spaces are then filled with dry sand, the purpose of which is to prevent the squeezing out of the pitch in hot weather. Unless this precaution is taken the pitch will be forced out to the surface of the street in large quantities owing to the high coefficient of expansion of pitch. The sand in the upper portion of the joints forms a mastic which holds the pitch below in place.

The ordinary construction was reversed in the street car tracks and dummy strips where a crown in the pavement is usually placed. The surface was made concave instead of convex and track drips were placed at 300 to 400 ft. intervals. The crown in the street car track in ordinary construction throws the water toward the rail and it percolates under the pavement with subsequent damage to the pavement. On the other hand a concave surface throws the water to the center of the track, where it passes to the track drips and thence to the sewer. In pavements constructed last season the depth of the concave surface was 1 in., but this year it has been increased to 1½ ins. It should be noted that this concave type of construction for car tracks is satisfactory only where there is sufficient longitudinal grade to carry the water off. Pavements constructed in this manner gave satisfactory service in Toledo last winter.

Comparative Cost

The cost of this type of construction is somewhat less than that of the familiar mortar-bed type. The smooth floating of the concrete surface to the desired degree of smoothness and regularity is now a simple process. The paint coat of pitch requires about ½ gal. of pitch to the sq. yd. of surface. The cost of labor and materials is decidedly less in this type of construction than in the mortar-cushion type. Experience so far has indicated that coal-tar pitch gives better service than asphalt, both for the coating and the filler. Tar adheres better to the concrete foundation than does asphalt and holds the blocks more firmly in position, while asphalt used as a bituminous coating on concrete may be peeled off in large sections with ease; it requires a pull of about 150 lbs. per square inch to loosen the blocks where pitch is used. If a paint coat of light oil is applied to the concrete before the cushion coat is applied asphalt can be used successfully.

The Choice of Fillers for Block Pavements

By John S. Crandell, Consulting Engineer, The Barrett Co., 17 Battery Place, New York, N. Y.

On the selection of the proper filler for pavements of the block type often depends the success or failure of the pavement. Too little attention has been paid to this very important factor, and many of our city pavements show plainly the lack of thought on the subject. It is common to hear a city spoken of as "a grout filler town," or "a pitch filler town." It will be found that the engineer of such a city has decided in his own mind that one certain kind of filler is the best, and he uses nothing else, although it could be easily demonstrated that some pavements require different treatment from others.

Types of Fillers

Perhaps the best way to compare the behavior of fillers is to take up each type of block pavement in turn, first defining the fillers used.

Sand Filler: Porbably the first filler ever used.

Pitch Filler: (Also called Paving Cement). Coal tar pitch made from refined coal tar, melting point between 110 to 150 deg. Fahrenheit (cube in water). This filler is used without the addition of other material in brick and wood block pavements. For granite block, pebbles are first swept into the joints. (See Granite Block, below.)

Pitch Mastic Filler: A mixture of coal tar pitch and fine sand in equal amounts. It can be used in all types of block pavements except plain rectangular wood block.

Asphalt Filler: A refined oil or natural asphalt, penetration 35-60. Used the same as pitch filler.

Asphalt Mastic Filler: A mixture of refined asphalt and sand in equal amounts. It is used like Pitch Mastic Filler.

Cement Grout Filler: A mixture of Portland cement, sand, and water. It is used in stone block and brick pavements.

These fillers are the ones usually used. Others have been tried from time to time, but have been discarded in favor of one or more of the foregoing. One filler that gave promise of excellent results was a sulphur and sand mixture. The objection to it was the extreme care necessary in heating the sulphur; only a carefully trained man could handle the mixture successfully, and after numerous failures it was given up. Premolded strips of bituminous materials have been tried, and some of them are in successful use as expansion joints, but they are not satisfactory for the bulk of the pavement.

Functions of a Filler

First of all, a filler should make the joints waterproof. If it fails to do so, then sand is as good a material as any, for all other functions are secondary considerations. Protection of the joints, foothold for horses, insulation against noise,

ease of removing and replacing blocks when cuts are made in the pavement, use of the pavement immediately after the filler is in place—all these will suggest themselves to the engineer as desirable qualities that a filler should have. While these are important they are by no means so necessary as the waterproofing value.

Granite Block Pavement

Pitch and Pebble Joint Filler—For many years the pitch-and-pebble joint filler was the only one known. Properly applied it is an excellent filler, and a better one has not been found for pavements laid with wide joints. Cincinnati uses this type at present even with close joints, and the results are good because the work is done right. Here the blocks are laid on a 1 in. sand cushion, and after laying, they are pinned with clean gravel which will pass a ½ in. circular opening and be retained on a ¼ in. opening. Much care is taken to secure a gravel that will pass this specification. Enough of it is swept into the joints to half fill them. Instead of then ramming the blocks they are rolled with a tandem roller. Hot coal tar pitch is poured into the joints so that they are half full. This is followed by a second application of gravel, which all but fills the joints, when a second pouring of pitch is made, completely filling them. Gravel is then cast over the surface, after which a flush coat of about ½ gal. of pitch per square yard is poured over the gravel, completely covering the pavement. Finally, finer gravel is strewn over the pitch flush coat, and rolled with a steam roller. The pavement is immediately ready for traffic. This is the correct way to make a pitch-and-pebble joint. There is no doubt about it being waterproof, and the experience Cincinnati has had proves it to be a filler admirably adapted to the use to which it is put.

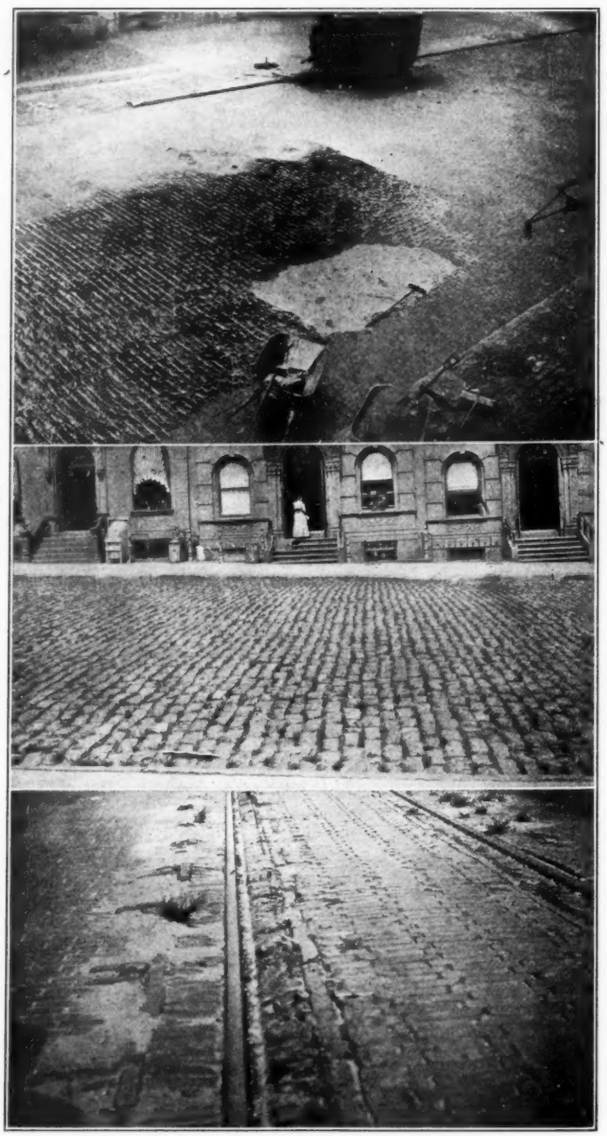
There are many miles of granite block pavements laid over 20 years ago in different parts of the country that have pitch-and-pebble joints in which the pitch is as lively today as when it was poured. Failures with this filler occur when, instead of filling the voids in the pebbles with pitch, sand is swept in on top of the pebbles, and a thin coating of pitch is spread over the top of the joint, or the pebbles are damp and wet. Good inspection will prevent such work.

Very little asphalt-and-pebble filler has been used, so that there is no opportunity for comparison to be made with pitch-and-pebble filler.

Pitch Mastic Filler—Pitch mastic filler was introduced in the United States in 1913 for use in modern granite block, where the joints are ½ in. or less in width. For these narrow joints pitch-and-pebble filler is unsuited, and a mixture of fine sand and paving pitch in equal amounts, by volume, was tried. The results have been very satisfactory when the mixture has been properly made and introduced into the joints. The qualities necessary in the ingredients are that the sand shall be fine and heated to 300 deg. F., while the pitch shall be of the correct melting point for the grade of the street, and have the correct free carbon content. The specifications of the American Society of Municipal Improvements should be followed, both for pitch mastic and for asphalt mastic.

Asphalt Mastic Filler—Asphalt mastic was introduced about 1915 in New York City. It has given good results when properly mixed and used. It is, however, more difficult to mix than pitch mastic due to the fact that asphalt should be heated to about 350° F. while pitch works best at 250° F. This also makes the operation of filling more difficult, as the asphalt mastic will not flow to the bottom of the joints if it drops below 275° F. In such cases the tops of the joints are "buttered" and the bottoms are empty. Pitch, on the other hand, flows to the bottom of the joints even at ordinary temperatures, thus sealing the joints at the bottom. This property has led some engineers to think that the pitch has left the joint entirely, but such is not the case. The asphalt mastic, by staying at the top of the joint, fails to show the condition at the bottom and for a while makes the pavement look better than the more perfectly filled pitch mastic joint.

An interesting experiment was tried on 31st and 32nd streets, between 3rd and Lexington Avenues, New York City in 1916. Modern granite block was laid on both streets. One-half of the joints of the paved area on each street was filled with pitch mastic, and the other half with asphalt mastic. An examination made recently shows that there is little difference. Both seem to be standing up well under the heavy mixed traffic.



FILLER IN BLOCK PAVEMENTS.

Upper View: Rush St., Brooklyn, N. Y., first Job of Pitch Asphalt Sand Filler. Pitch and Asphalt Mixed on Street in Kettle. Granite Block. Middle View: Grass Growing in Sand-filled Joints in Granite Block Pavement, East End Ave., New York City. Lower View: Brick Pavement 20 Years Old, with Sand Filler, on Madison Ave., Montgomery, Ala. Ties Have Rotted and Rail Movement Pumps Sand Out.

The Borough of Brooklyn, New York City, has been using since 1917 a mastic, the bituminous portion of which is composed of 4 parts coal tar pitch and 1 part asphalt. The pitch has a melting point (cube in water) of about 115° F., and the asphalt has a penetration of 35. The melting point of the mixture is about 145° F. To date the results have been very satisfactory.

Grout Filler—Portland Cement grout has been used in many cities as a filler for granite block pavements. In some it is an unqualified success, while in others it is unquestionably a failure. Some of the failures are due to faulty mixing and applying. Some are due to the quality of the granite, the climate, and local conditions. Some are caused by failure to realize that grout should never be used in pavements on heavy traffic streets liable to be torn up frequently, such as those in the Borough of Manhattan, New York, or the Loop district in Chicago. Assuming that the grout has been properly mixed and applied, it will be found that soft blocks will very soon shatter and fail, due to the non-yielding filler which is harder and stronger than the blocks themselves. If soft blocks are scattered through the pavement, there will be here and there spots that sooner or later are going to become holes. When cuts have to be made it is impossible to remove the blocks without breaking them, if the grout is of good quality, and if it is not good the pavement will not be waterproof. Again, it is impossible to repair the cut pavement so that the cut does not show. For this reason streets in undeveloped sections, or districts that are growing should never be paved with a grouted block pavement. Grout should be allowed at least 10 days to set. This precludes its use in pavements in business districts. As against these instances we have the splendid grouted granite block streets of Havana, Cuba. An excellent grade of Swedish granite, combined with good grout and a warm climate, make for perfection. Perfection, however, is not attained, for there is a disagreeable rumble and roar heard when iron tired drays traverse the pavements. This same racket has been very disagreeable in Boston where grout has been used; here a bituminous filler is used along the curb to prevent the vibration of the monolithic pavement being carried into the office buildings.

VIEWS ILLUSTRATING USE OF PITCH FILLER FOR BLOCK PAVEMENTS.

Renapt Granite with Pitch and Pebble Filler. East Pearl St., Cincinnati, Ohio. Old Granite Block Laid About 15 Years Ago on Columbus and Manhattan Avenues, New York City. Note Pitch Sticking to Blocks.

Durax

Durax pavement consists of small cubes of granite laid on a dry mortar bed. Undoubtedly the best filler for this pavement is a mastic. Grout is not satisfactory.

Medina Block

Medina sandstone is not hard enough to take very heavy traffic. It is not strong enough to stand internal stresses set up when grout is used, and almost all grouted Medina sandstone pavements have shattered areas. It does not cut regularly enough to give a close joint, and hence the pitch-and-pebble filler is the best that can be used. Pitch mastic and asphalt mastic have given satisfaction.

Brick

Undoubtedly the first filler ever used in brick pavements was sand. The writer has examined many miles of brick pavements in Holland and Belgium with sand filled joints which are upwards of 75 years old. These pavements are sometimes cited to show what wonderful results can be obtained with paving brick and a simple sand filler. But these same pavements, if subjected to the traffic of a modern American city, would not last a month. The writer recorded in his diary (1912) that during two full days spent on some of these brick highways leading out of Amsterdam only five motor cars were counted, and no motor trucks. The traffic consisted of dog-carts, and light horse drawn wagons carrying vegetables, milk and cheese. There are a few cases of sand filled brick pavements in this country that have lasted well, and are today in good condition. But they are exceptions. All engineers are agreed that something better than sand is necessary.

Opinion is divided between the advantages of soft fillers, i. e., pitch or asphalt, and cement grout. This is due to the fact that there have been many successes and failures with both types. Pitch was probably the first filler used after sand, and in the early days of the tar industry there was no laboratory control of the output. The result was that the right grade of pitch was not always supplied for the job. Today, when a proper specification can be met by any well-equipped plant, there is no excuse for not getting the right quality and grade of pitch. Yet often a contractor orders a hard roofing pitch for a paving job, and complains if it chips out of the joints in cold weather. A paving pitch of the right consistency will insure a watertight pavement.

Some of the early blown asphalt fillers were worthless. They had no adhesive strength, and could be lifted out of the joints in strips; such fillers did not prevent the entrance of water. Today a better grade of asphalt can be had, and if the specifications of the American Society of Municipal Improvements are followed a satisfactory filler will be the result.

If the bricks have well defined lugs, or are of the vertical fibre type, a mastic filler is preferable to either plain pitch or asphalt. There is less tendency for a mastic filler to run out of the joints, as the sand tends to stiffen it.

In spite of the large number of failures of brick pavements due to cement grout filler, an enormous yardage is laid every year with this material. The reasons are that grout is cheaper than a soft filler, it is easy to use and the street presents a good appearance when it is new.

There are numerous examples of grouted brick streets that are in excellent condition after many years' use. There are more examples that are far from being satisfactory. Usually brick streets and roads less than 20 ft. wide stand up well when grouted. Wider streets are less satisfactory; because of the danger of cracks appearing, and the rumbling of traffic when the brick are laid on a sand cushion. Blow-ups, while

not common, do occur from time to time and are a source of danger and annoyance. It has been held that grout protects the edges of the joints better than a soft filler. This is true, but it is also true that if the brick are of the best quality the edges need no protection; and further with the increasing number of rubber tired vehicles and the rapid retirement of horse drawn traffic the edges do not require the protection that formerly was thought necessary. What was said of shattering of the surface in grouted granite block pavements is even more applicable to those built of brick. A soft brick starts the process, and soon a rather large area has failed. It is a very difficult matter to patch a grouted brick pavement successfully, and the countless bad patches verify this. It can be done, but only by experienced men and at the cost of considerable care and expense.

Wood Block

There seems to be more unanimity of opinion over the filler to be used in wood block pavements than with any other kind. Most authorities agree that coal tar pitch is the only satisfactory filler.

Sand is favored by a few engineers of experience if the traffic is heavy enough to broom out the top of the blocks so as to make a tight joint. Market Street, Philadelphia, and Washington Street, New York, are good examples of this. But unless the traffic is exceptionally heavy, the pavement will fail, for it is essential that a wood block pavement be waterproof.

Grout has been tried, but within a few days after it has been in use the grout has broken up into small pieces, so that its waterproofing value is zero. To use grout in wood block pavements is to waste money.

Asphalt has been used to some extent, but it is not a success. The creosote oil with which the blocks are treated has a softening and disintegrating effect on the asphalt, so that its waterproofing value is lessened, and its stability is reduced. In the course of time it loses all value as a filler.

Coal tar pitch is a true waterproofing agent for creosoted wood blocks. A pitch of proper melting point (140°-150° F.) must be used. The action of the creosote in the blocks is to cut back the pitch, or soften it and thus lower its melting point, without changing in any way its quality. It is for this reason that a high melting point is desirable at the beginning, since after a year in the pavement the pitch will be found to be of lower melting point, and hence capable of permitting easy expansion and contraction of the blocks. Disagreeable bleeding is prevented if the blocks are properly treated, if they are laid hand tight without ramming, if the joints are not filled more than two-thirds with pitch, and if the surface is sanded.

Summary

On the whole there have been fewer failures and better work when block pavements have been laid with soft or bituminous fillers than with sand or grout. There is undoubtedly greater waterproofing value in bituminous fillers than in cement grout. A greater number of desirable qualities are inherent in the bituminous fillers than in grout.

(Engineers who have studied the performance of various types of fillers in block pavements are invited to express their views on this subject.—Editor.)

SEWER DESIGN AND CONSTRUCTION

Sewage Collection and Disposal Proposed at Los Angeles Harbor

By W. T. Knowlton, Engineer of Sewers, Los Angeles, Calif.

In connection with the delevopment of the Harbor District of Los Angeles, the matter of sewers and sewage disposal received early attention as it was realized that without such improvements the development of the Wilmington and Terminal Island Sections in this part of the city could not progress very much. Accordingly plans were made for both the collection and treatment of sewage in these two portions of the Harbor District shortly after these sections were consolidated with the city of Los Angeles.

In Wilmington it became necessary to raise the level of the land adjoining the water front between 7 and 8 ft., before a proper drainage system could be installed. Prior to this being done sewers were laid in the business portion of the Wilmington District, the outlet for these being into the Wilmington basin at the foot of Fries Avenue and Canal Avenue.

Existing Plant For East Wilmington

Later plans were prepared and a sewerage system installed for the easterly part of Wilmington, so that the sewage from this part was collected at a disposal plant at the easterly end of the east basin of the inner harbor and there treated before discharging into this basin. This plant has now been in operation about three years, and consists of a pumping plant, Imhoff settling tank and sludge bed. Since its completion the plant has given satisfactory results, no odors therefrom being noticeable. The amount of sewage treated by this plant is approximately 150,000 gals. per day, the population served being approximately 1,000 people. It will be noted that the amount of sewage pumped may show the presence of ground water, which is due to the fact that the lower portion and outlet of the sewer into the sump chamber of this pumping plant is about 8 ft. below mean low tide.

Shortly after this East Wilmington plant was installed it was considered that a similar treatment should be applied to the sewage from the other portions of Wilmington as well as to the condition on Terminal Island. To provide for this work, bond issues were proposed which included a similar treatment of the sewage of San Pedro. As, however, bond issues for other matters than sewage treatment were considered at the same time, the election held in 1916 for sewer bonds failed to obtain the necessary number of votes, and a similar result occurred in the following year, when a second election was held for sewer bonds under similar conditions.

Plans for Collection and Disposal

During the present year, however, the conditions at the harbor concerning the matter of sewage disposal are once more receiving considerable attention, due mainly to the necessity of providing sanitary conditions for the housing of those employed at the shipyards at the harbor. In a report of the housing conditions made in April by the State Commission of Immigration and Housing, it is stated that to accommodate the workers in the shipyards a large number of houses should be erected as under the present conditions these workers are obliged to travel many miles each day in going from their homes to work. As a result of these conditions, the writer has been instructed to prepare the necessary plans for the collection of sewage in both the Wilmington and Terminal Island Districts..

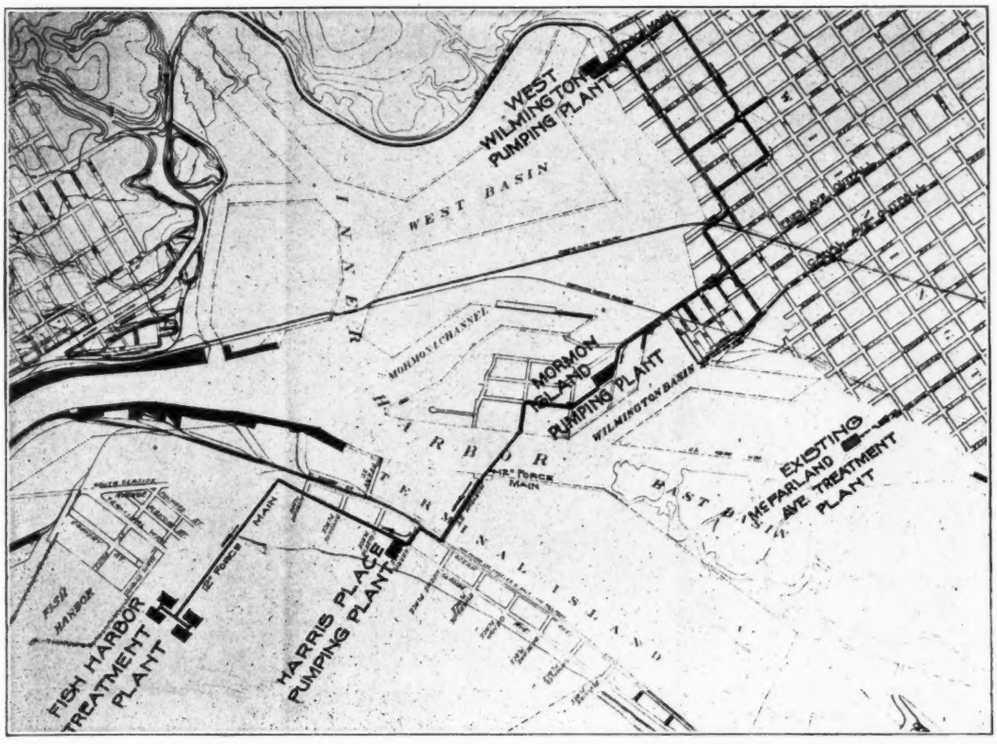
Cannery Wastes

At the present time, as above noted, the sewage from the central or business portion of Wilmington is discharged in a crude condition into the upper end of the Wilmington basin. This condition in itself has not caused especial objection, but with the growth of the canning industry in this vicinity, and the lack of a proper method of treatment, it has been found that the harbor waters at the mouth of the outfall sewers as well as that along the wharfs at the north end of Mormon Island have become so polluted that there is not sufficient oxygen therein to prevent the material discharged from causing obnoxious odors near the mouth of the outfall sewers and adjacent to the discharge from the canneries. To remedy these conditions it has been planned to collect all sewage now discharged from the Fries Avenue and Canal outfall sewers as well as that which is discharged from the canneries and convey this sewage, as well as that of the West Wilmington District, to a pumping plant proposed to be installed on Mormon Island. At this plant the sewage would have all sand and screenings intercepted before discharging into the pumps, which would force the sewage therefrom across the channel between Mormon Island and Terminal Island and into a treatment plant proposed to be installed about one-quarter of a mile east of Fish Harbor on land proposed to be reclaimed by the city for commercial and industrial purposes. At the present time this land has a depth of water along the ocean front 10 ft. or more below low tide, which will indicate that foundation work will probably be required in the installation of the settling tanks proposed for this site. It is also planned that the force main to be laid between the Mormon Island pumping plant and the treatment plant at Fish Harbor will intercept the sewage collected on Terminal Island, and thus provide for a long needed installation of a sewerage system in this section of Los Angeles.

The population benefited by this proposed work at Wilmington and Terminal Island is at the present time but a fraction of that which is anticipated, and provision has been made for an ultimate population of 10,000 people. The estimated cost required for the construction of the necessary pumping plants in Wilmington and Terminal Island together with force mains and with the settling tanks and sludge beds required at Fish Harbor is $135,000 and a request that this sum be obtained for this purpose has been sent by the Board of Public Works to the City Council. The accompanying plan shows the location of the work proposed. It might be added that consideration has been given to other means of treatment than that adopted and also, that due attention has been given to the location of the disposal site.

Discharge of treated sewage into the main channel of the inner harbor has some merits; however, this disposal is not as satisfactory as that proposed at Fish Harbor, where the tidal current will properly dispose of the treated effluent when discharged at a proposed depth of 15 ft. below low tide.

As only tentative plans for this proposed treatment of sewage have been made, details concerning installation of this work cannot at this time be given.



LOCATION OF PROPOSED SEWAGE DISPOSAL PLANTS AT WILMINGTON AND TERMINAL ISLAND, LOS ANGELES, CALIFORNIA.
Existing Sewers in Dotted Lines. Proposed Sewers, Force Mains and Disposal Plants in Solid Lines.

Conditions Calling for Separate or Combined Sewers

The separate and combined system of sewers each has its advantages, and the question of which system is the best adapted to any given locality requires careful consideration of the influencing factors, a number of which are here enumerated as stated in the report of Alvord & Burdick to the city of Billings, Mont., upon the extension of the storm water sewer system.

Separate System of Sewers

Among the conditions which indicate that a separate system of sewers is desirable, may be mentioned:

First—Where storm water does not require extensive underground removal, or where it can be concentrated in a few shallow underground channels.

Second—Where drainage areas are short and steep, facili-

tating rapid flow of the water over street surfaces to the natural water courses.

Third—Where the sanitary sewage must be pumped and the additional cost of pumping even a small amount of storm water is great. In this case especially is it true that if the overflow of storm water into a water course is not permissible, the separate system has great advantages.

Fourth—Where the sanitary sewage must be purified and storm water in a combined system either purified or by-passed—either scheme requiring large purification plant capacity or creating nuisance due to the overflow of objectionable refuse.

Fifth—Where the sewers are being built in advance of the city's development to encourage growth, the sanitary system provides a maximum of miles of sewers for a minimum expenditure. The storm sewers if ever required, may be built later, and rarely need cover over about one-half the area covered by a sanitary system.

Sixth—Where an existing sewer is laid at grades unsuited to receive sanitary sewage, it may frequently be used as a storm sewer.

Seventh—A combined system must usually be relatively of larger capacity than a separate storm drain for the same area, and the reason for this is that a storm drain may be overloaded at long intervals with slight inconvenience, whereas, on account of basement connections and the sewage carried by a combined sewer, any overflow is accomplished by great nuisance and complaint.

Eighth—The separate system has greater advantages in districts where the population is not dense, and where the proportion of sewage to rain water will always be relatively small.

Combined System of Sewers

Among the conditions which indicate that the combined system is desirable, are:

First—Where it is evident that both storm water drains and sanitary sewers must be fully and completely installed throughout the entire district, the total cost will be greater for the separate system than for the combined system.

Second—Where no pumping or purification is required at present or is anticipated in the future.

Third—Where the district is densely built up and the proportion of sewage to rain water is great. There is a further advantage of the combined system in closely built-up sections, on account of the fact that surface washings are present in greater quantity, and if they are carried into combined sewers decomposible matter will be deposited in the sewers, causing nuisance after the storm water flow has ceased.

The selection of which system of sewers to adopt obviously does not follow any hard and fast rules. It is frequently found that portions of a city can be best sewered on the separate plan, while other portions of the same city can be best sewered on the combined system.

WATER WORKS DESIGN AND CONSTRUCTION

Increase in Water Consumption in Certain Massachusetts Municipalities

By Bertram Brewer, Formerly City Engineer and Superintendent of Sewers and Water Works in Waltham, Mass., Now Special Asst. Engineer, Massachusetts State Department of Health, Boston

The writer has recently had occasion to investigate the current general increase in water consumption in some Massachusetts cities and towns. For purposes of comparison, a table has been prepared which includes also the Metropolitan District of Boston. Populations and a comparison of consumption records for the months of May and June, 1917, and May and June, 1918, are shown in Table I.

Table I.—Populations and the Percent. Increase in Water Consumption for May and June, 1918, over May and June, 1917, in Massachusetts Cities

	Population.	% Increase, 1918.
Stoneham	7,750	*
Fall River	125,000	3.5
Everett	40,550	4.9
North Andover	6,100	5.0
Chelsea	47,350	11.0
Waltham	32,000	12.0
Boston	788,000	13.7
Lawrence	106,000	14.0
Somerville	92,600	14.9
Met. Dist. Boston & vicinity	1,237,000	16.5
Revere	29,100	19.3
Belmont	9,200	19.7
Lexington	5,900	24.9
Milton	9,200	27.3
Melrose	17,800	28.7
Malden	52,000	29.8
Winthrop	14,500	33.2
Swampscott	7,900	36.8
Medford	34,400	37.0
Watertown	18,400	42.0
Arlington	16,800	46.3
Nahant	1,500	75.3
Quincy	44,000	75.8

*Stoneham's increase for May was 9%. In June there was a decrease of 4.3%.

The percentages are approximate only and the figures of population do not include summer residents or increases due to the war.

It is interesting to note that of these 22 communities only one, Stoneham, has shown any saving in water consumption over 1917. The increase runs as high as 75% in the little town of Nahant, which is solely a residential community on the sea coast. Some of these increases are plainly largely due to war work as at Watertown and Quincy. Strange to say, the large manufacturing cities of Fall River and Lawrence are away down in the list, but this is no doubt due to the fact that most of the large manufactories have their own private water supplies.

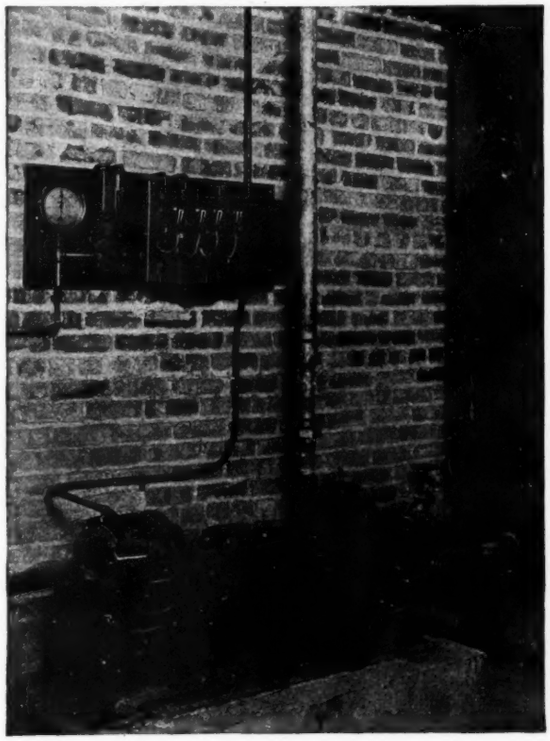
A resume of the published figures for consumption in the Boston Metropolitan District shows a noteworthy, almost steady decline in consumption from 1908 down to and including 1915, from an average of 128 gals. per capita to 88 gals. In 1915 the decrease was 4.96%. In 1916 when war work began to be a considerable item, there was an increase of 1.01%, in 1917 a further increase of 1.1%, while on the May and June basis there will be an increase in 1918 of 16.5% over 1917. The bulk of the increase cannot be due to the war and this table speaks for itself. The conclusion is obvious that the severe

weather of last winter has left in its trail a problem of leak finding for the Massachusetts communities at least, that will take the best skill on the part of those in charge to solve. Water works superintendents have a patriotic work to do of no small moment because these millions of gallons of wasted water are directly related to the coal pile and the winning of the war.

The Remote Control of Motor-Driven Pumps and Compressors

By F. M. Nourse, Engineer, The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Remote control of motor-driven machinery is probably more extensively used with pump and compressor applications than with any other class of machinery. The purposes for which the pumps and compressors are used as well as the

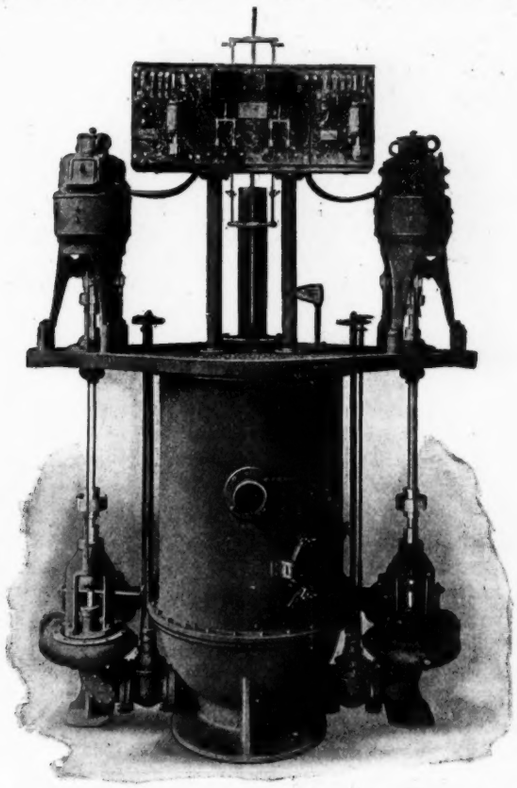


THREE H. P. 3-PHASE MOTOR DRIVING HOUSE PUMP CONTROLLED BY PRESSURE REGULATOR AND SELF-STARTER MOUNTED ON WALL.

methods of controlling them vary a great deal yet in general the main object is to change the water or other fluid from one level to another; or in a closed system to do the equivalent by increasing or decreasing the pressure. To enumerate all of the different applications of pumps and compressors would require a great deal of space. However, those applications with which we are most familiar are: village and city water systems; sprinkler systems; railway water tanks; sewage disposal and purification systems, including sump and bilge pumps in buildings and areas below the surrounding drainage level; drinking water systems for hotels, apartments, office and factory buildings; hydraulic elevators; and coin and sidewalk lifts. Compressors and vacuum pumps are often used to operate some of the above as well as to furnish compressed air, or create a vacuum for almost innumerable purposes.

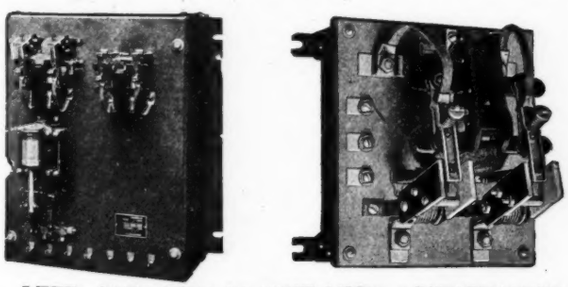
The Automatic Motor Starter

While hand operated starters and regulators are entirely satisfactory for some applications, the automatic motor starter has a number of advantageous features that make it particularly desirable for pump and compressor control. The remote



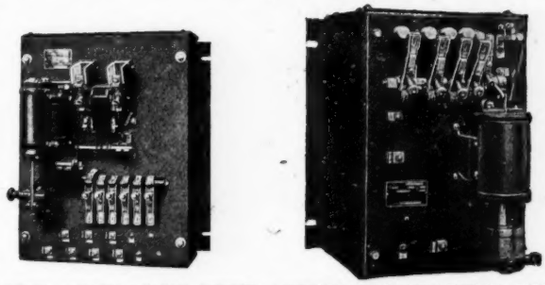
YEOMAN'S FORM A CENTRIFUGAL SEWAGE EJECTOR WITH TIME-LIMIT TYPE AUTOMATIC STARTERS MOUNTED ON TOP.

control feature enables an attendant to control the motor from any convenient point. All the operator has to do is to push the button, and the automatic starter brings the motor up to speed with promptness and safety. One or more push buttons or snap switches may be used, located wherever desired;



LEFT—ONE FORM OF TIME-LIMIT ACCELERATION-TYPE AUTOMATIC MOTOR STARTER FOR SINGLE AND POLY-PHASE INDUCTION MOTORS.

RIGHT—ACROSS-THE-LINE TYPE STARTER FOR SINGLE OR POLY-PHASE INDUCTION MOTORS.



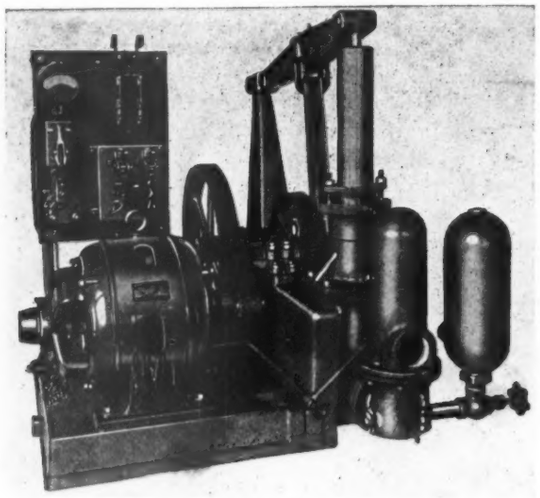
LEFT—TIME-LIMIT TYPE AUTOMATIC STARTER FOR A. C. SLIP-RING MOTORS.

RIGHT—A TYPICAL TIME-LIMIT SELF-STARTER FOR D. C. MOTOR.

or a float switch or pressure regulator may be used in place of the push button stations to provide complete automatic control. Automatic control permits the maintenance between fixed limits of the water level in a tank, or the maintenance between limits of water or air pressure in a compression system, or vacuum in a vacuum system, while the automatic operation of the starter itself accelerates the motor properly, irrespective of the skill of the attendant.

Adapting Controlling Apparatus to Size of Motor

The motor used may be for either direct or alternating current. If direct, it may be either series, shunt or compound



TYPICAL PUMPING EQUIPMENT FOR COUNTRY RESIDENCE SHOWING PUMP, 5-H. P. MOTOR, A. C. STARTER, DIAPHRAGM-TYPE PRESSURE REGULATOR AND PRESSURE GAUGE.

wound. If alternating it may be one, two or three phase and of either the squirrel cage or wound motor types. If the motor is of small capacity and does not take excessive current when starting, a float switch, diaphragm type pressure or vacuum regulator may be used to connect the motor directly to the line. The float switches have larger current carrying capacity than the diaphram type pressure and vacuum regulators but float switches as a rule cannot be used to handle motor currents above 5 HP. It is evident therefore, that for larger motors some form of automatic starter must be used to handle the motor current. Where there is no objection to connecting the motor directly to the line a starter consisting of a double-pole magnetic operated switch may be used; however, when the motor is of larger capacity it becomes necessary to provide some means for reducing the starting current. This may be accomplished in several ways. The most common of which are: by inserting resistance between the mains and the motor terminals in the case of the single phase and squirrel cage type induction motors and by inserting resistance in the

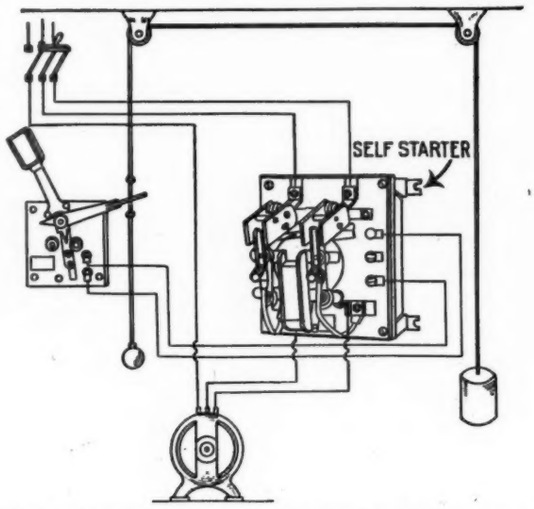
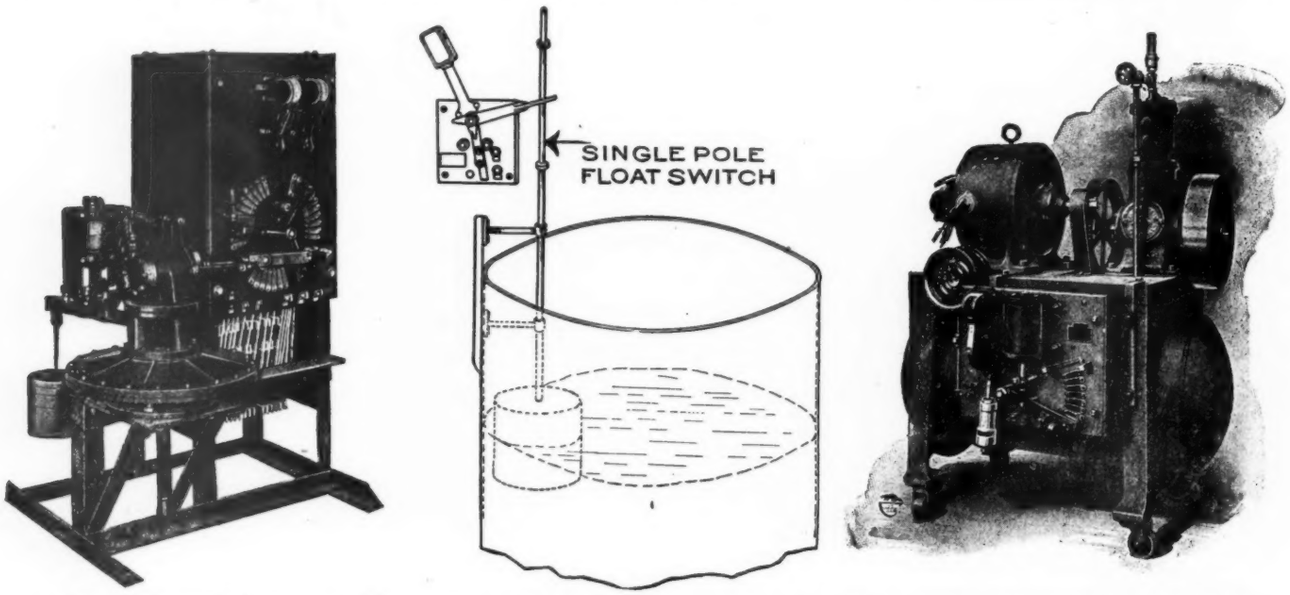


DIAGRAM SHOWING CONNECTIONS BETWEEN A. C. AUTOMATIC STARTER, FLOAT SWITCH AND THREE-PHASE INDUCTION MOTOR.

rotor circuit of slip ring type induction motors, or by inserting resistance in the armature circuit of direct current motors.

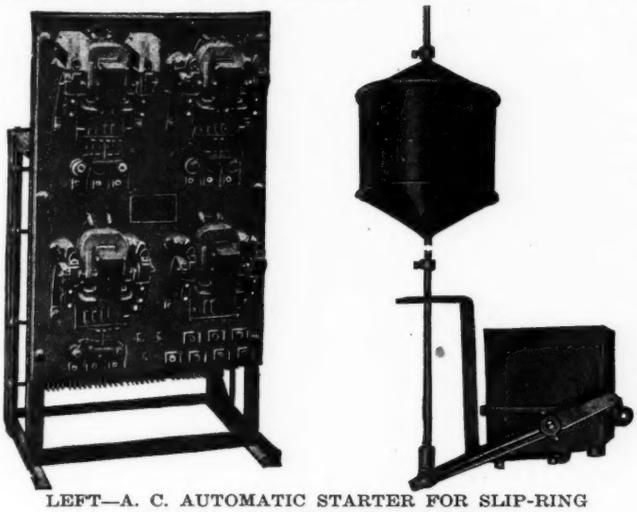
Two General Types of Automatic Starters

Two general types of automatic starters for limiting the starting current and providing proper acceleration are the time limit and the current limit types. With the time limit type the motor is brought up to speed in the same period of time at each start. The period of starting can, of course, be adjusted within given limits. Automatic starters designed for



LEFT—A PRESSURE-CONTROLLED SPEED REGULATOR FOR A. C. POLY-PHASE MOTORS. CENTER—ONE METHOD OF INSTALLING SUMP FLOAT AND FLOAT SWITCH. RIGHT—PORTABLE AIR COMPRESSOR WITH GAUGE-TYPE PRESSURE REGULATOR AND TIME-LIMIT TYPE SELF-STARTER.

current limit acceleration do not bring the motor up to speed in a given time, but the amount of current taken is limited. If the load started by the motor is heavy the motor is accelerated slowly, if the load is light, the motor is brought to speed quickly. In either case the current does not rise above a predetermined and adjustable amount.



LEFT—A. C. AUTOMATIC STARTER FOR SLIP-RING MOTOR, CURRENT-LIMIT TYPE.
RIGHT—ENCLOSED FLOAT SWITCH ARRANGED FOR WALL MOUNTING.

Speed Controllers

Aside from starting duty, controllers are also made for regulating or varying the speed of motors, the two general classes being the automatic and the hand operated.

Pump and Compressor Applications

For pump and compressor applications the automatic starter can be for either direct or alternating current, depending on the motor used, and can be of either the current limit or of time limit type depending on the type of pump and nature of the service. Typical forms of both types of starter for alternating and for direct current are shown in the accompanying illustrations. Any of the automatic starters shown can be controlled by a single pole knife or snap switch; by an open or enclosed float switch; by a diaphram or gauge type pressure or vacuum regulator or by a push button station having one normally open and normally closed button.

Float Switches

Float switches are made both open and enclosed. The open type are made with one or two poles and are generally used for tank and pump service where there is no danger of the contacts sticking, due to frozen moisture or an accumulation of dirt. The enclosed switches are made with one, two, three or four poles and although they cannot be submerged they are splash proof. Float switches are operated by the rising or sinking of a copper float as the water in the tank rises or falls. For tank service the switch is closed at low level and opened at high level. For sump service the arm is reversed, so that the switch is closed at high level and opened at low. The enclosed switches are made with various mounting arrangements—such as clamping over the edge of a tank—for inside wall of tank, and for outside of tank with the shaft extended to project through the tank wall. One style also has a floor pedestal and can be arranged to be operated either by the float and rod with upper and lower stops, or by float, chain and weight. Usually the single pole float switches are used in connection with a suitable self-starter. The two, three and four pole switches are used to control directly alternating current motors of less than one horse power.

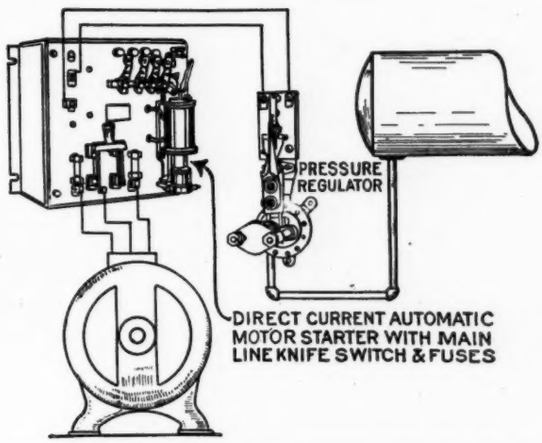
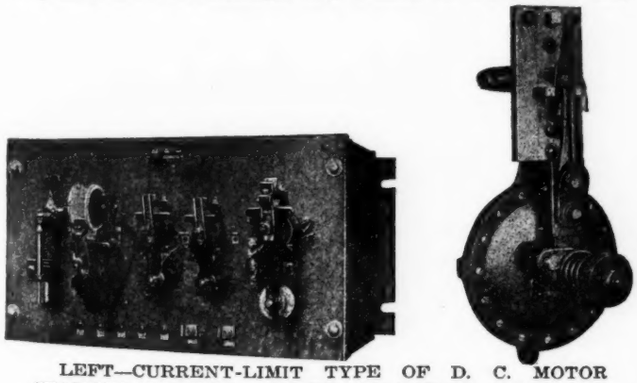


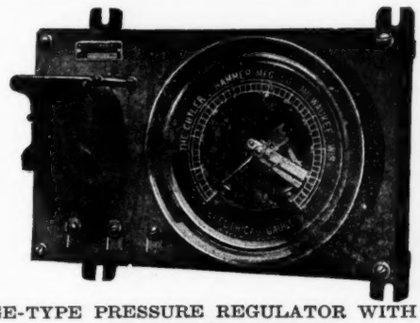
DIAGRAM SHOWING D. C. AUTOMATIC STARTER, PRESSURE REGULATOR AND MOTOR.

Diaphragm Type Pressure Regulators

Diaphragm type pressure regulators are used for pressures above atmospheric only. They are designed primarily to act as a pilot switch in connection with a motor self-starter. The single pole type may be used as a single pole switch for connecting across the line a small direct or single phase alternating current of a capacity not greater than ¼ HP. 110 volts. or ½ HP. 220 volts. The two pole regulators may be used to connect across the line direct current motors not larger than 1 HP. and two and three phase alternating current motors not larger than 3 HP. These regulators open the switch at high pressure, and close it at low. When it is required that the switch close at high pressure and open at low, a special regulator must be used. The diaphragm type regulators may be used on systems containing air, gas, water, or any other fluid which is not injurious to the rubber diaphragm. These regulators should be connected to an independent pipe from the tank, and not to the discharge pipe from the pump. This is to insure that it will not be affected by the fluctuation in pressure in the discharge pipe. If this is not possible, a small air tank or chamber should be installed between the discharge



LEFT—CURRENT-LIMIT TYPE OF D. C. MOTOR STARTER HAVING THREE MAGNETIC LOCK-OUT SWITCHES, MAIN SWITCH AND OVERLOAD RELAY.
RIGHT—DIAPHRAGM-TYPE VACUUM REGULATOR.

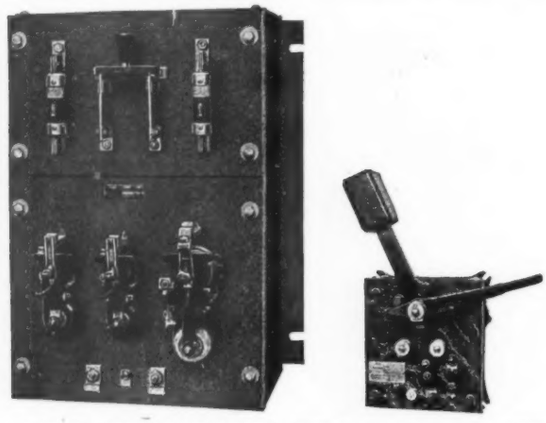


GAUGE-TYPE PRESSURE REGULATOR WITH MAGNETIC PILOT SWITCH.

pipe and the regulator to act as an air cushion. A stop-cock should also be provided to make it possible to throttle the supply pipe. Pressure regulators should always be mounted in a vertical position. Two wires are required to connect the regulator with the self-starter.

Diaphragm Type Vacuum Regulators

Diaphragm type vacuum regulators are for use on pressures below atmospheric only, and are designed primarily to act as a pilot switch in connection with a motor self-starter. They may be used, however, with small direct and alternating



LEFT—CURRENT-LIMIT TYPE OF D. C. MOTOR STARTER, HAVING THREE MAGNETIC LOCK-OUT SWITCHES, KNIFE SWITCH AND FUSES.
RIGHT—SINGLE-POLE OPEN FLOAT SWITCH.

current motors or not over ½ HP. to connect them directly to the line. Vacuum regulators usually open the switch at high vacuum and close it at low. Special vacuum regulators can be had to close at high vacuum and open at low.

Gauge Type Pressure Regulators

Gauge type pressure regulators are of the circular enclosed type and for use on pressure or vacuum systems. They are designed to handle solenoid currents only and must always be used in connection with a suitable self starter. It is often necessary to provide a relay in connection with the gauge to handle the starter solenoid current, the gauge carrying only

LEFT—SINGLE-POLE DIAPHRAGM-TYPE PRESSURE REGULATOR.
CENTER—DOUBLE-POLE OPEN FLOAT SWITCH.
RIGHT-DOUBLE-POLE DIAPHRAGM-TYPE PRESSURE REGULATOR.

the current required to operate the relay. On pressure systems the gauge should be connected to an independent pipe from the tank, and not to the discharge pipe from the pump, for the same reason given in the paragraph on diaphragm type pressure regulators.

Artesian Wells for Water Supply, with Special Reference to the Artesian Wells of Wisconsin

By W. G. Kirchoffer, Consulting Sanitary and Hydraulic Engineer, Madison, Wis.

The name artesian comes from the province of Artois in France, where wells of this character were first drilled and used extensively about the year 1800. Originally this was intended to apply only to those wells which flowed at the surface, but now it is quite generally understood to mean any and all deep wells in which the water rises above the formation from which the water flows. That is to say, supposing that in drilling a well several hundred feet of limestone or shale is penetrated and then a layer of sandstone is reached, if the well is artesian the water will rise from this layer of sandstone to a point comparatively near the surface of the ground. If it is not artesian, it will not rise above the surface of the sandstone. Thus we see that the only essential difference between a flowing and non-flowing well is that the surface of the ground, in the case of a flowing well, is below the level at which the water would rise from the water-bearing formation and that in the case of the non-flowing well the elevation of the ground at the site of the well is higher than the elevation to which the water will rise from the water-bearing formation.

Early Wisconsin Wells

The date of drilling the first artesian well in Wisconsin cannot conveniently be given, but according to a United States census private companies started water supply systems at Fond du Lac in 1840, at Prairie du Chien in 1876, and at Kenosha in 1880. At all of these places the water from the wells was under sufficient pressure to flow from the wells through the mains and into the house service pipes. The continued use of water in this way gradually reduced the pressure to such an extent that after a number of years it was impracticable to operate this system by this natural pressure. The system at De Pere, although not put in at such an early date as those mentioned above, has the distinction, however, of being the last city which was supplied with water in this way, as it was only in 1905 that the system was changed over to pumps and storage reservoirs.

In 1865 and 1866 wells were drilled at Palmyra and Oil City, Vernon county, with the idea of striking oil. The reason for making these borings was because there was a slightly oily substance discovered on the surface of the water flowing from a spring. Later this substance turned out to be a compound of iron. In 1875 a well was drilled at Prairie du Chien which had sufficient pressure to operate a water wheel which ran a mill. When the Mississippi river was at a high stage this water wheel was under water, but was always on the job. The old mill and water wheel are still in existence, but have not been used for a great many years.

The Essential Condition

The essential condition for the existence of artesian wells is a relatively porous stratum to receive and transmit the water lying between two strata that are relatively less porous, but not necessarily impervious. An inclined stratum of sandstone, with an up-turned edge lying between two layers of limestone or shale, furnishes this condition. The stratum must be inclined, or its edge turned up as an outcrop, to furnish an area for the collection of the water, and the outcrop must be at a greater elevation than the water-bearing stratum at the well, in order to supply the necessary pressure for a flow to take place through the stratum.

The conditions surrounding the existence of artesian wells could be compared very readily with a water works system in which we have an elevated tank or reservoir supplying the system of underground mains from which service pipes are run into the houses. The reservoir is comparable with the outcrop of the water-bearing formation, the system of underground pipes with the stratum of sandstone, sand or gravel which transmits the water, and the pipe leading to the house with the well. There is really nothing mysterious about an artesian well or spring, as some people have supposed. They are as simple as any problem in mechanics. There must be sufficient rainfall to soak into the stratum and to keep all of the pores well filled with water. Many other qualifying con-

ditions affect the quantity of the flow or the pressure, but they will not be discussed here.

There are in general two methods by which water finds its way through the strata: through the pore spaces of the rock and through fissures or between the lamina of the strata. The amount of water that can pass through the pore spaces in the majority of rocks is comparatively small. It is believed by the writer, from observations made upon the flow of water in Potsdam sandstone into a mining shaft, that the most of the water flowing through rock runs along the beds of the laminae or bedding planes of the rock, and that a comparatively small amount of water passes upward or downward through the rock unless it does so through fissures.

Sources of Artesian Water

In Wisconsin the main sources of artesian water are the Potsdam and the St. Peters sandstones. Some good flows are found in the Niagara limestone and occasionally in the Trenton limestone. The glacial drift also furnishes some small flows. The crystalline rocks and the shales are much too compact to transmit the water or have not the essential conditions for a flow.

The exact dividing line between the areas in which artesian water may be secured and that in which it cannot is difficult to define. In a general sense an artesian supply can be secured anywhere south of the general outcrop of the Potsdam sandstone.

A flow at the surface may be secured in most of the river valleys in this area, and especially is this true of the Mississippi, Wisconsin, Rock, Fox, Kickapoo and Baraboo river valleys and along the shores of Lake Michigan and Lake Superior.

From the data secured from a large number of wells it has been determined that the water will rise in most localities to an elevation of about 830 ft. above sea level or 250 ft. above Lake Michigan. It has also been determined that where the elevation of the ground considerably exceeds the above limit the water will stand at a higher elevation. This is probably due to the fact that there is little or no leakage from the water-bearing strata and that some additional water may percolate into the well from higher strata.

Along Lake Michigan and in the Mississippi valley, where the surface is much below the above limit of 830 ft., a reversal of conditions takes place, and it is found that the water will reach an elevation of about 700 ft. This is no doubt due to the greater leakage from the strata.

The clay rocks (shales, etc.) are too compact to be in any available degree water-bearing; they are the chief confining strata.

The crystalline rocks are much fissured at the surface and may afford additional collecting area for the outcrop of the overlying pervious sandstones. The beds of an open or porous nature are the only reliable sources for artesian wells; they are sand, gravel, sandstones and conglomerates.

Velocity of Flow

Although enormous quantities of water flow through these water-bearing sandstone and gravel beds and furnish supplies to many cities and private enterprises, yet the actual velocity through these formations is exceedingly slow. The ordinary velocity which one would expect to find in a sandstone formation would be from 1 ft. to 3 ft. per day, and in sand and gravel formations the velocity varies from this distance per day in fine material up to 100 ft. per day in very coarse material, as found by Professor Slichter in his under-flow investigations. It is very improbable that the velocity through the Potsdam sandstone in Wisconsin has a velocity as high as 100 ft. per day, but supposing that it did, we find that by making proper computations it would take at least 70 years for the water to flow from the collecting area to the Madison wells, and that, if the velocity was as low as 2 ft. per day, it would take about 500 years.

We have often heard it repeated in public meetings and elsewhere by those supposed to be familiar with this subject that the reason Madison is short of water in the winter time is because the pores in the rock near Lake Superior freeze up and the water cannot get through, but in the spring when the frost is out of the ground there is plenty of water. Even though the water did come from Lake Superior, which it does not, from the above statement one can readily see that a vast period of time would elapse before the water would reach Madison from that source, unless it came over-ground or was carried by railroad train. As a matter of fact, it is absolutely impossible for the water of Lake Superior or Lake Michigan to ever get into the artesian wells, because there is a great barrier of granite between Lake Superior and the southern end of the state and a thickness of 800 ft. of limestone between Lake Michigan and the central portion.

Artesian Waters Not Chemically Pure

While artesian and ground waters in general are usually pure from a sanitary standpoint, they are not pure from a chemical standpoint. That is to say, nearly all underground waters carry either in solution or suspension large quantities of mineral matter. These, of course, vary according to the character of the soil over which the water flows and the character of the underlying sand, gravel and rocks into which the water percolates. From a large number of analyses of waters it has been found that the effect of the drift, which was left by the glaciers, upon the mineral content of spring waters is not as marked as one might suppose. Out of 25 ordinary springs, of which 14 were known to flow from the drift and 2 from the rock, the latter contained only two minerals which the drift did not, viz., potassium chloride and sodium carbonate, and these were in very small quantities. Sodium chloride, calcium carbonate and silica were found in all of them. All other minerals present occur in about the same percentage of drift waters as of rock waters.

Mineral Content

The principal minerals which are found quite universally in both ground and artesian waters are the sulphates of sodium and calcium, the carbonates of sodium, magnesium, calcium and iron, and the chloride of sodium, together with alumina and silica. All sulphates, though occurring in small amounts, are more prominent in drift waters than in rock waters, whereas the carbonates occur as frequently in the rock as in drift waters, but the quantities of carbonates, especially those of magnesium and calcium, are found to be more uniform in the rock waters than in the drift.

From a careful study of some 70 analyses of ground and artesian waters it was found that the chlorine in 13 artesian waters from a depth of 800 to 1,350 ft. averaged 0.645 parts per 100,000; in 8 artesian waters, from a depth of 300 to 800 ft., the average was 0.657 parts per 100,000, while in 11 waters, from a depth of 100 to 300 ft., the average was 0.532 parts per 100,000. These figures, when compared with those for springs and shallow wells, will illustrate the foregoing statement regarding saline matters.

From such information as is at hand, it would appear that the mineralization of all artesian waters increases as the southern end of the state is approached and increases from the center of the state towards the east and west; or, in other words, the degree of mineralization follows the natural trend or dip of the rocks.

At Sheboygan, where the St. Peters sandstone is at the greatest depth below the sea level, we find the most highly mineralized water; also at Manitowoc, Sheboygan Falls and Milwaukee highly mineralized waters are found. At Prairie du Chien, on the western border of the state, where the bottom of the Potsdam sandstone has never been reached, we find a highly mineralized water.

Iron Content

The fact that iron is mined extensively in the northern

part of the state is sufficient evidence that it will be present in some water at least. Whenever water stands in or passes through formations containing iron, so long as free oxygen is present, the iron remains in a ferric condition and is entirely insoluble. The water drawn from such strata is free from iron, notwithstanding the fact that it has been in contact with large quantities of that substance. If, however, the supply of oxygen becomes exhausted in the ground, and the organic matters, often present in the soil or water, reduce some of the iron in the ground to the ferrous state (that is, some of the oxygen in combination with the iron is taken away by the organic matters), the iron in this reduced or ferrous state is quite soluble in water containing a little carbonic acid, and the water drawn from such strata contains iron in solution, usually as ferrous carbonate. It is thus seen that it is the conditions in the ground and water which cause the presence of iron in the water. These facts would seem to explain how it is that a water when first pumped is free from iron, but after a time iron is found to be present and in ever increasing amounts.

The above statement possibly may explain, at least to a certain extent, the reason why the water in the outskirts of some cities is not of as good quality as it was years ago, when the wells were not pumped to the extent that they are to-day. Various methods have been tried to remove this iron from the water, but few have ever been entirely successful. The most successful process. however, is that of aeration with a double contact of cope, and either mechanical or sand filtration. No doubt many waters would be greatly improved if they were subjected to a thorough aeration process as pumped from the wells by air lift pumps, and then allowed to settle in the reservoirs.

WATER PURIFICATION AND SEWAGE TREATMENT

Prevention of Imhoff Tank Foaming at Schenectady, N. Y.

By Harrison P. Eddy, of Metcalf & Eddy, Consulting Engineers, 14 Beacon St., Boston, Mass.

The foaming of Imhoff tanks has been a source of much embarassment to many operators of sewage treatment plants during the last few years. At Schenectady foaming was almost continuous in 1916, even in winter and spring when the temperature was very low. Last winter at Plainfield, New Jersey, also, the tanks continued to foam through the winter. As the foam escaped it froze and formed volcano-like mounds several feet in height, through the center of which a passageway was maintained for the escape of the continuous supply of foam. Nevertheless, foaming generally stops altogether, or continues at greatly reduced rate, during the period of low temperature.

Many plans for preventing foaming have been tried, and described in engineering literature. In some cases the foaming has ceased, temporarily at least, apparently because of the establishment of conditions favorable to digestion, but adverse to the phenomenon of foaming.

Conditions at Schenectady

The plant at Schenectady has been one of the most troublesome, because of the continuous and violent foaming. Experience at this plant was described by Earl Devendorf, then superintendent of the sewage treatment plant, in Engineering News-Record, April 4, 1918.

Schenectady has a population of about 100,000. When the Imhoff tank plant was built it was found necessary to curtail expenditures and construct but one-half of the tanks originally contemplated. In addition, foundation difficulties led to reducing their depth. As constructed, there are nine tanks having a maximum depth of 14.3 ft. and a free-board of about 0.8 ft. There is no means available for measuring the daily sewage discharge. It is estimated, however, to be from 8 to 10 million gallons, and it has been assumed that a population of about 65,000 is tributary to the plant. On this basis the gas and scum space above the slots is equivalent to 0.7 cu. ft. per capita.

Each tank is divided longitudinally into two sections and transversely into 16 hoppers, by concrete partition walls. Each hopper is provided with a gas vent about 2 ft. wide by 8 ft. long and has an 8-in. cast iron sludge pipe extending vertically to a tee about 5 ft. below the surface of the sewage, from which a side outlet pipe passes to an open sludge drain. The outlet of this pipe is closed by a gate valve. Above the tee is a short length of cast iron water pipe with the bell at the top. This bell is open and is about 6 ins. above the surface of the sewage as the tanks are normally operated.

Sewage Temperature

The municipal water supply is taken from large wells and is comparatively hard and of low temperature. During 1918 the average monthly temperature of the sewage has been as follows:

January	47.2°F.
February	46.4°F.
March	45.4°F.
April	42.4°F.
May	55.4°F.
June	55.1°F.
July	60.6°F.

The sewage is relatively fresh and much of the time contains a substantial quantity of dissolved oxygen. At night and early in the forenoon the sewage is noticeably diluted, undoubtedly due to much infiltration of ground water.

The freshness and relatively low temperature of the sewage during the early spring have in effect prolonged the season during which bacterial action is at low ebb and therefore have tended toward increasing the accumulation of undigested solids during this period of the year. Consequently, with the advent of warmer weather, bacterial action has been very violent.

Breaking Up Scum

There has always been a marked tendency for the suspended matter to rise to the surface and form a great mass of scum in the gas vents. Frequently it has been impossible to draw sludge, because the solids were almost entirely floating at the surface of the sludge compartments.

At times as many as five men have been continuously employed in breaking up the scum. Even when men were employed night and day, spraying the gas vents with water under high pressure, to drive down the scum and prevent foaming, some of the gas vents would foam over between the applications of water. This condition was much aggravated by the low freeboard, only a short period of time being required for the foam to rise sufficiently to overflow into the sedimentation compartments.

Corrective Measures Employed

To aid in controlling this condition the gas vents were raised about 12 ins., by means of wooden boxes. This provided a free-board of about 20 ins., the tops of the boxes being about 14 ins. above the bells of the sludge pipe risers.

Thus as the scum and foam rise in the boxes they can be drawn off through the sludge pipe risers. To facilitate this, a wooden plug attached to long handle, is pushed down below the tee in the sludge pipe, thus practically closing the lower portion of the pipe and preventing the escape of sludge. The scum and foam can then flow into the upper portion of the pipe and pass out through the side outlet into the sludge channel. When the scum is very thick and somewhat dry, it is necessary to break it up with a hoe or shovel and draw it to the riser. A small stream of water from a garden hose, discharged into the riser, facilitates the passage of thick scum through the pipe.

Controlling Foaming by Drawing Sludge or Scum

It has long been apparent at Schenectady, that foaming can be controlled by drawing sludge or scum. If the solid matter in the sludge compartments is entirely gas-lifted, it must be withdrawn, either in the form of scum from the top, or it must be driven down by means of hose streams and drawn in the form of sludge. In the latter case it is necessary to draw the sludge almost immediately after driving the scum to the bottom, otherwise the solids will be lifted again by entrained gas and the sludge will have disappeared.

Careful observations have been made by Mr. John V. Lewis, superintendent of the Sewage Treatment Plant, and by the writer, to ascertain if the drawing of scum is attended by the escape of more objectionable odors than the drawing of sludge. These observations have led to the conclusion that there is no noticeable difference, both appearing to be free from any odor other than the usual "tarry" smell.

Foaming Increased by Hosing Scum in Vents

Experience during the past year has led to the conclusion that foaming is encouraged by hosing the scum in the gas vents. This work has been carried to an extreme at Schenectady, because of the troublesome conditions which have existed. By it large quantities of clean water, containing dissolved oxygen, are introduced into the sludge compartments, which may favor the growth of organisms tending to produce carbon dioxide rather than those which produce methane. Accordingly, the use of water has been almost entirely given up during the past summer and foaming has practically ceased. Were it not for the fact that the sludge-drying bed area is too small, which has led to the postponement of drawing sludge and scum on some occasions, foaming could have been entirely controlled without the use of water.

Conclusions

As a result of the operation of this plant during the last three years, it appears that foaming can be entirely prevented or controlled by the drawing of well-digested sludge or scum, and that hosing encourages foaming and is useful merely in preventing the overflow of the foam in some cases where it is temporarily impracticable to draw the sludge or scum.

Some Design and Construction Features of the New Slow Sand Water Filtration Plant at Auburn, New York

By J. Walter Ackerman, Chief Engineer and Superintendent of Water Works, Auburn, N. Y.

In 1907 an epidemic of typhoid fever broke out in Moravia, and in the following year Auburn suffered an epidemic in the spring which cost the lives of 12 people out of 28 cases of typhoid. This started the agitation for a filtration plant and construction work was started on July 2, 1917. Due to unusually bad weather in the summer of 1917, when during the month of July there were 28 days of rain, the construction work was greatly hindered. Though hampered this year by labor conditions, the contractor has been able to make rapid progress, and it is expected the plant will be in full operation by July 1, 1919.

Slow Sand Process Adopted

After a thorough investigation slow sand filters were adopted, for the reason that the source of supply, Owasco Lake, is a large natural reservoir which is practically free from color and turbidity most of the time. The removal of pathogenic bacteria was the greatest problem and the slow sand process was adopted as the surest means of removing the bacteria, either when the raw water is clear or slightly turbid.

General Design

The general design is the usual one of concrete, with groined arch roofs, with all of the concrete in compression, so that no general reinforcing is necessary. The plant consists of four beds of about 0.4 acre each, and is so arranged that the raw water and the purified effluent pass through one combination regulator house, laboratory and sand washer, all under one roof. There is also a 3,000,000-gal. pure water reservoir to take up the fluctuation of the daily load in order to allow the filler to operate at a fixed rate.

Excavation and Embankment

No particularly novel methods were used in the construction of the plant. Excavations were largely made by steam shovel, of which there was a total of about 30,000 yds. A small fraction of the bottom of the filters is placed on rolled embankment in order to keep down the excavation to the necessary amount in order that the excavation would about balance up the fill around and on top of the filters. Rolled embankment was made also on the edges of the walls of the filters where the excavation was not deep enough to provide for solid earth to take up the roof thrust against the side walls.

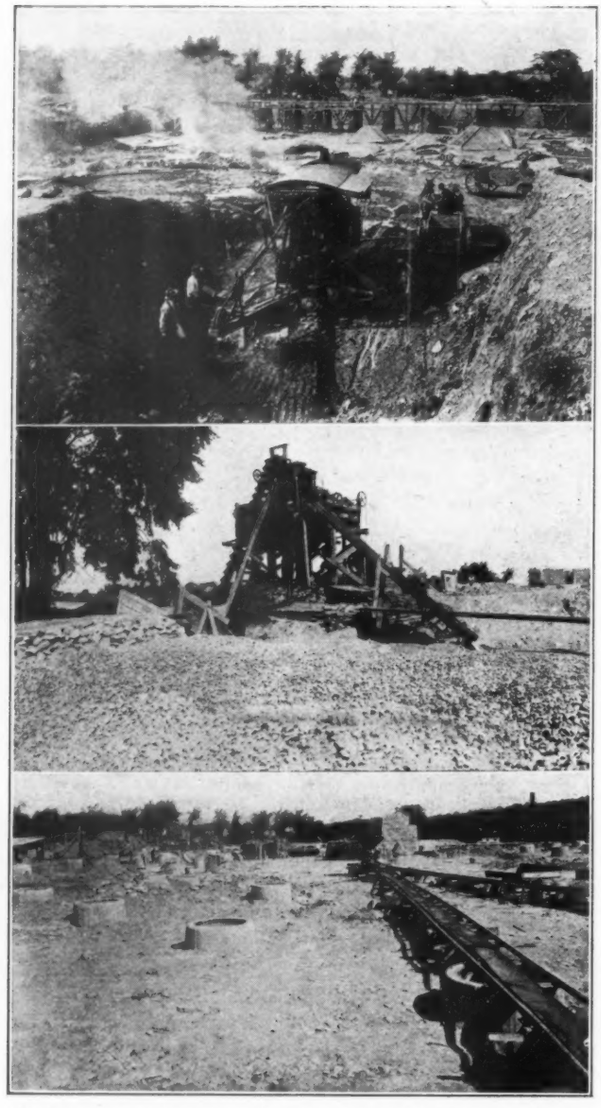
Strange to say, the greatest difficulty in the contract has been in the excavation. The tender for the contract stated that the excavation was hardpan, and subsequent evidence proved that this was no misnomer. Whenever any finishing had to be done by hand to secure an exact grade it was found that the workmen were almost unable to make any impression on the hardpan with ordinary picks, so that from the contracting standpoint the excavation was a losing venture. The contract, however, was let under a main contract as Contract "A" which included all of the excavation and the furnishing and placing of all concrete and completing all of the contracts. The material such as cast iron pipe, gates, valves and all appurtenances, was secured in separate contracts but was placed under the main contract, "A." Contract "A" was let to the J. E. Bunting Co., of Flushing, Long Island.

Concreting

The concrete was made, mostly, of local bank gravel after being screened in order that proper proportions of sand and gravel might be maintained. A self-filling batch mixer was used for the concrete with an automatic water control. The delivery of the concrete to place was accomplished by means of two-wheeled push carts that traveled on well constructed elevated run-ways which were high enough to pour all piers and side walls. The bottom slabs were generally poured by wheeling on the completed portions of the bottom already in place. The loading of the mixers was accomplished by means of a skip moving up an inclined track and operated by a steam winch, the steam being drawn from the same boiler that furnished steam for the mixers. This skip was arranged so that when the compartments were just filled with the gravel, sand and cement, the proportions were exactly correct.

The wall forms around the sides were made in sections 13

ft. in length with tapered keys on the end. The sections were built alternately, that is, a form would be set with sides and end bulk heads; this form would then be poured, and moved 26 ft. and again poured and then the intervening space of 13 ft. between the two complete sections would be filled by clamping the outside wall forms and pouring the space full of concrete. In order to hold the forms together bolts were used as difficulty was experienced in securing wires that were reliable enough to hold. When using the bolts they were greased and then wound with tarred paper so that after the concrete set up the bolts could readily be removed and the holes plugged and filled with cement.



VIEWS ON CONSTRUCTION OF AUBURN, N. Y., WATER FILTRATION PLANT.

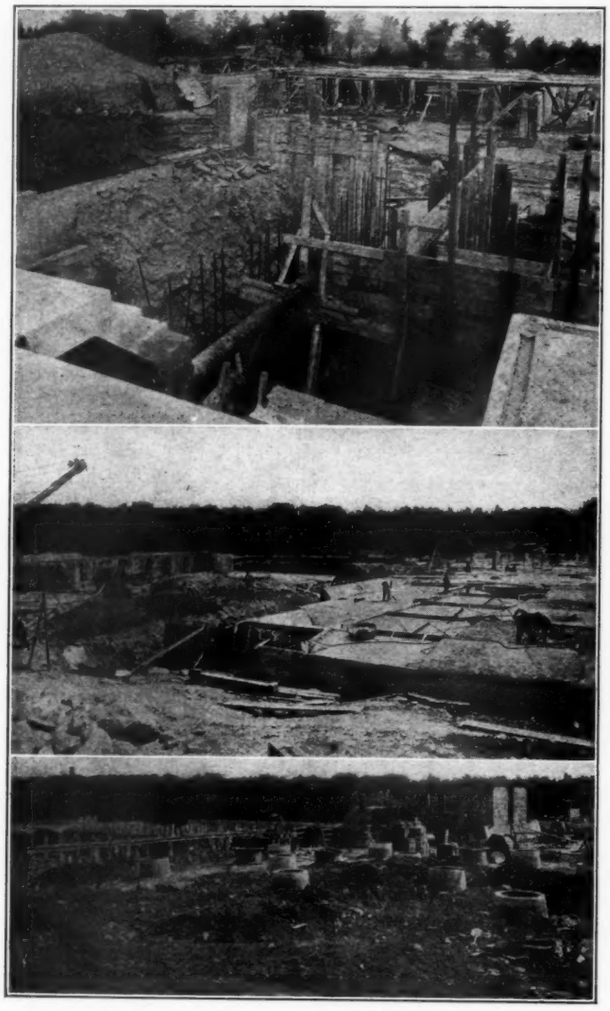
Keystone Steam Shovel Excavating for Filter Beds—Sand Screening and Washing Equipment—Industrial Track to Transport Filter Sand Over Top of Beds.

Locating and Concreting the Piers

The pier forms were of wood and so cut and mitered as to fit well around the piers and to form comparatively tight joints. By simply covering these joints with building paper they were made practically watertight. It was necessary to locate these pier forms very accurately and this was accomplished as follows: The point for each pier was determined by transit and tape, and the pier forms were so made that they can be taken down and reassembled. On setting a pier form on the floor of the filter, the intersection of two lines at right angles to each other was made to show the exact position of the center of the pier to be erected, and on the forms were also two lines. These bisected the center of the side of the form so they were placed exactly over the lines on the floor of the filter, then a plumb line was dropped from a template placed in the top of the form and the form then adjusted until the plumb was exactly over the center of the floor. The forms had to be weighted down to a considerable extent on account of the taper on the bottom and would lift if not so weighted.

Screening and Placing Filtering Material

Contract "B" was for screening and placing the filtering material in the beds and was awarded to the L. D. Sullivan Co., of Utica, N. Y. The sand contract has presented the usual



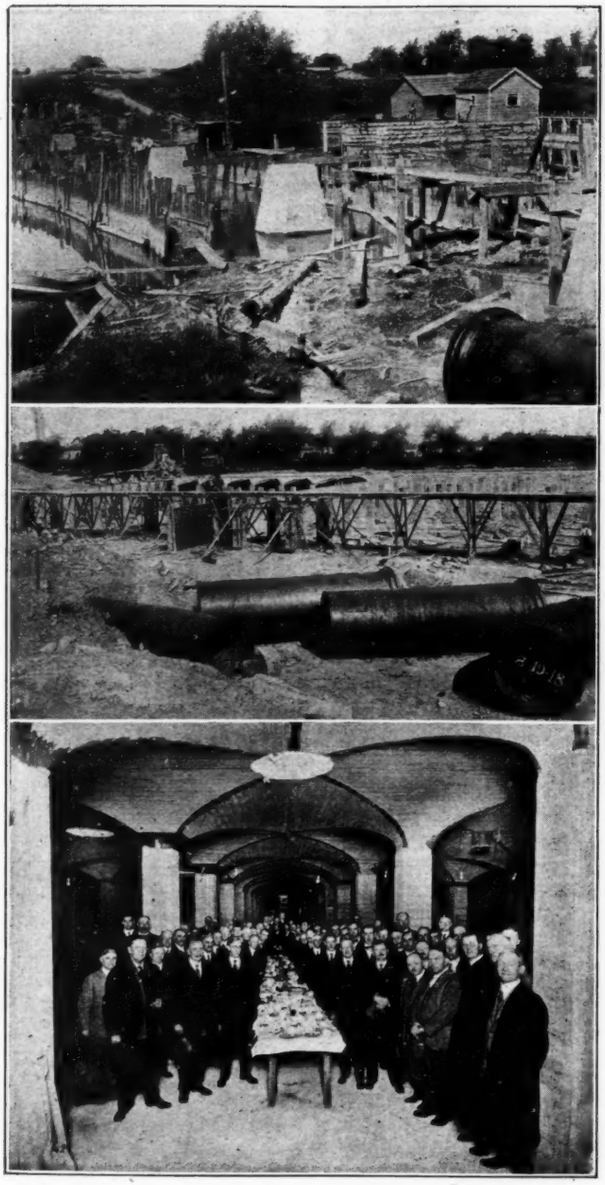
CONSTRUCTION VIEWS ON AUBURN, N. Y., FILTER PLANT.

Forms for Regulator House in Foreground; Concrete Mixer and Runway in Distance—Roof Forms—View of Part of Completed Filter Beds; Regulator House Partly Constructed in Middle Distance; Two Other Filters at Left Under Construction.

problems of screening and washing and while a very carefully worked out plan has been completed it was necessary to change it a number of times in order to get the results desired.

The screening apparatus consisted of rotary screens in which the first separation was the sand and gravel which would pass through the ⅜-in. mesh; the balance of the gravel

then went on and was again sorted into two sizes, one being all that would pass the 2½-in. mesh and be retained on the 1-in. mesh, and the other that which will pass the 1-in. mesh and be retained on the ⅜-in.; then the sand and fine gravel would next be sorted by a $\frac{3}{16}$-in. mesh. This constituted the three grades of stone or gravel, the coarser one being placed around the under-drains of the filters and the two finer on top of that, and then the sand. The sand, after being screened, would drop into a washer box with sloping bottom containing



VIEWS OF NEW SLOW SAND FILTER AT AUBURN, N. Y.

River Crossing for 36 in. Raw Water Pipe; Cofferdam in Distance for One of the Piers—Concrete Runway; Cast Piers and Wall in Place; Roof Forms in Distance—Auburn Rotary Club Taking Lunch Inside Filter No. 1.

five 2½-in. pipes, and in which there was overflow troughs about 2½ ft. above the pipes.

The pipes were punctured with staggered ¼-in. diameter holes in the top and were supplied with water under pressure. This caused an upward current to pass through the sand, washing out organic matter, and the finer particles of sand were carried up and wasted out through the troughs. This was so adjusted to leave the effective size of the sand to be not less than 0.25-mm. nor more than 0.35-mm., and also so that the sand should not contain more than one per cent. finer than 0.13-mm. and the uniformity co-efficient should not be more than 3.0. To satisfy all of these conditions of the sand requires a lot of manipulation and the proper selection of the sand at the bank.

The bank from which the sand was obtained was one about a mile from the works. A Thew ⅝-yd. revolving steam shovel loaded the sand into the trucks and the trucks dumped the sand into the hopper from which an endless chain elevator carried it up and dumped it into the screen mentioned. The water for washing the sand was supplied by a 6-in. centrifugal pump, pumping about 400 ft. from the filter site. This pump delivered about 500 or 600 gals. per minute, and beside the pipes inside of the sand washing box there was some placed on top and by the side of the revolving screen to aid in the operation.

The Auburn water works is a municipally-owned plant, has a separate existence from the other city departments, and is governed by a commission of three men, one of whom is appointed each year. It has always attracted the best men of the town as it is considered an honor to be a Water Commissioner, and most all of the Commissioners have served a number of terms. For instance, at the present time two of the members are now serving their eleventh and twelfth years, respectively. This, of course, cannot help but create a continuity of effort which means a fulfillment of any definite and set program and explains why at the present time we are constructing a filter plant, even though the project was conceived and started more than eight years ago; but as it was conceived and started eight years ago the Board persisted in its predetermined effort and at last surmounted all obstacles and the work is well under way at the present time.

On the completion of one filter bed and before the sand was placed in it, the Rotary Club of the city of Auburn held one of its meetings inside of the filter. This was due to the fact that they were instrumental in conducting a propaganda in favor of water filtration, and took this way of celebrating the successful consummation of their plans. Mr. Allen Hazen, of the firm of Hazen, Whipple & Fuller, of New York City, was the consulting engineer.

Water-Borne Typhoid Outbreak Due to Neglect of Chlorinator

During May, of this year, a serious water-borne epidemic of typhoid fever occurred in California, where the water supply nominally was chlorinated. The occurrence of the epidemic shows how easily water chlorination may prove a disastrous failure if not carefully and competently supervised.

Merced Falls, where the epidemic occurred, is a small lumber town of about 350 inhabitants, located on the Merced River in the foothills of the Sierras. The entire town and its utilities are controlled by the Yosemite Lumber Co., which has extensive mills at this point. The town is located on high ground. Streets and buildings are clean and attractive. Complete sewerage, leading to a septic tank which empties into the river below town, has been in existence for a number of years. The water supply is pumped from the same river just above town.

Nominal Chlorination and Filtration

Following an epidemic a few years ago, a chlorinator and a pressure filter were installed. Filter alum is used, presumably, but the water is extremely soft and as coagulation is not provided, the filter is practically nothing more than a strainer. Entire dependence must be placed on the chlorinator for bacterial results.

The first chlorinator installed was an Electro-Bleaching Gas Company's machine, but corrosion became so serious that, in August, 1917, a Wallace & Tiernan solution-feed chlorinator was substituted, applying the disinfectant into the pump

suction, from which the water was pumped to a small elevated tank. Distribution is from the tank and off the pump force-main. The principal weakness in the installation appears to be that some of the water lines on which the machine depends for its pressure become affected with sawdust and the pressure becomes so low that the solution jar can not be kept full of water, causing the chemical to attack the cylinder jar head.

Onset of Epidemic

An April 15, Dr. D. I. Aller, company physician at Merced Falls, began to receive a few cases of diarrhea. The maximum number of cases occurred during the latter part of April or early in May. Between 50 and 75 per cent. of the residents of the town were affected by the diarrheal disturbance. On May 1st two cases of typhoid occurred. Subsequently, the incidence appears to have been as follows:

First week in May	6 cases	(one death)
Second week in May	2 cases	
Third week in May	4 cases	
Last week in May	1 case	(secondary)

Water Supply

On May 14, when the epidemic was about over, the State Board of Health was informed and Dr. Frank L. Kelly, acting director of the Bureau of Communicable Diseases, and Mr. Ray F. Goudey, Assistant Engineer in the Bureau of Sanitary Engineering, proceeded to Merced Falls. Investigation showed that on April 20 to 23, Dr. Aller began to suspect the presence of a water-borne epidemic of diarrhea. On investigating the chlorinator he found the solution jar head entirely corroded and the machine out of commission. He was unable to learn when the machine first began to give particular trouble or when it went out of commission entirely. He at once requisitioned a new head but this was not ordered until about May 1. It was installed about May 4 or 5, but the dosage was probably low until May 18. A dose of 1.1 lbs. per million gallons was in use on May 15. On May 18 the chlorine supply at the water chlorinator ran out and the cylinder of chlorine was taken off the sewage chlorinator and moved to the water chlorinator. Only 4 lbs. of chlorine were contained in it, however, and it was applied at the low rate of 1.5 lbs. per million gallons, in an effort to conserve the supply until a new cylinder could arrive on May 20. An emergency disinfection was arranged on the sewage by Mr. Goudey, consisting merely of two 50-gal. barrels in which a solution containing 5.25 lbs. of bleaching powder per barrel was made up and fed through an ordinary ¾-in. valve (the smallest valve obtainable) into the outlet of the septic tank. This arrangement was set up and operating within 30 minutes. A man was detailed to watch the working of the plant continuously until the new supply of chlorine arrived.

Merced River Watershed

Suspicion pointed so strongly to the water supply as responsible for the outbreak, that a sanitary survey of the watershed was made in order to locate the source of the typhoid and diarrhea contamination of the river, as the population on the watershed is relatively very small.

Above Merced Falls the Merced River has a watershed lying entirely in the Sierras, having an area of about 1,050 square miles. Close to its headwaters is the Yosemite Valley, 71 miles above Merced Falls. Two highways cross the watershed with Yosemite Valley as the objective. One railroad meanders up the river 54 miles above Merced Falls, with El Portal as its terminus. There is no highway along the river. The only industries of any importance are timbering in the vicinity of El Portal, mining in a small way at several points along the river, and the summer resort business in Yosemite Valley and at Wawona, the latter being on one of the tributaries of the Merced River. Not over 850 people live on the entire watershed and of this number 300 live at Coulterville, so situated that the possibility of stream pollution is remote. About 200 were living at Yosemite Valley, at the time, in resorts having good sewage disposal.

A sanitary inspection of most of the other places on the river was made in connection with this and previous investigations, the findings in three of these places being as follows:

Bagby, 24 miles. This place is quite a settlement, consisting of hotel, store, postoffice and saloon, about 50 people; water supply from springs in winter and from the river in summer. Sewers enter the river from hotel and store, other premises use privies, poor condition. Analyses indicate B. coli in 1 c.c. above and below Bagby.

Mountain King, 32 miles. This is also quite a settlement, about 60 people; water supply from springs in winter and from river in summer. Recent analyses of springs show gross contamination. Six sewers into river.

El Portal, 54 miles. Seventy people, 5 to 10 people use river water, others use springs. One septic tank, serving four houses, discharges into river, two privies in bad shape.

Sewage unquestionably enters the river at El Portal, Mountain King and Bagby. Elsewhere privies are in use and conditions such that there is little likelihood of pollution of the stream except in the rainy season. With the exception of the summer resorts at Yosemite and Wawona, the population is fairly permanent at this time of year. Water supplies are usually from springs at this season, though later in the year many of the settlements use river water direct.

Animal Pollution

Animal pollution is quite extensive at various points below El Portal. The B. coli content of the river water is higher than can be explained by the number of people sewering into the river and the dilution.

Rainfall

During the month of April there was a slight fall of rain, about April 20. The gauge at Merced registered 0.03 in. and the records show a slight fall of snow at Yosemite.

Stream Flow

According to daily gaugings at Merced Falls between March 15 and May 10, the maximum flow recorded on March 19 was 15,000 second-ft., decreasing to about 3,000 second-ft. on March 26, when it increased to about 7,500 second-ft., dropping gradually to about 3,000 second-ft. on April 11, when it rose to 4,000 second-ft. on the 13th, slightly increasing again on the 20th to about 6,000 second-ft. at which flow the river remained quite consistently to May 10.

Analyses at Merced Falls

The following analyses of the raw river water are on file in this office:

January 22, 1918	0.5 B. coli per c.c.
March 21, 1918	0.1 B. coli per c.c.
May 16, 1918	0.1 B. coli per c.c.

These analyses do not indicate what would be termed a gross contamination of the river. They are approximately what would be expected from a watershed having the sanitary conditions as found by the sanitary survey here reported.

The foregoing data and discussion are from an article in the Bulletin of the California State Board of Health for July, 1918, by C. G. Gillespie, Director, Bureau of Sanitary Engineering, and Dr. Frank L. Kelly. Their conclusions follow:

Conclusions

All the evidence points clearly to this epidemic as typically water-borne. There is no suspicion that it could have been due to the ingestion of contaminated milk or food or to unsanitary surroundings.

The outstanding features of this epidemic are:

1. The sparse population on the watershed, about 0.8 per square mile.

2. The high dilution by the river of the sewage of people contributing directly at the time of the epidemic, probably 40 million gals. of river flow per person actually tributary.

3. The low B. coli content in the raw river water at Merced Falls, probably not over 0.5 per c.c. at the time of the infection.

4. The failure of chlorination at the very time when it was needed as the sole line of defense against infection. The investigation revealed that no one responsible for the chlorination felt the weight of his responsibility. Time and again the State Board of Health has urged, directed and ordered greater vigilance.

The facts as gathered show simply that poor operation and the lack of interest finally culminated in a corroded solution jar head about 10 days, and possibly more, prior to the appearance of the epidemic; that nothing was installed as an emergency, and considerable delay elapsed after the order for the part was placed with the manufacturer of the machine.

The company now agrees to appoint a full-time operator in charge of sanitary equipment in order to make every improvement conducive to continuous chlorination, including the better gauging of the flow of water, the frequent reading of the chlorinator, the weighing of the chlorine used and on hand, the keeping of a weekly report of operation, and the periodic sampling of the raw and treated water.

The Merced River is perhaps as innocent appearing a stream as any in the state, not excepting the multitude of creeks which now furnish water to the bulk of the Coast Range cities and towns. At this time of year its flow is tremendous, yet its sources and pollution can almost be counted on the fingers. The experience at Merced Falls illustrates and proves the contention that, at least in the present age, vigilance is the price of freedom from typhoid.

BRIDGES AND BUILDINGS

Low-Water Highway Bridges in Oklahoma

By J. W. Evans, Assistant Engineer, Oklahoma State Department of Highways, Oklahoma City, Okla.

A difficult problem in bridge building in Oklahoma has been partially solved by the use of low water bridges. Many of the western streams in the plains region flow through wide flats and have shifting channels with low banks in beds of sand. They carry little or no water except at times of sudden and infrequent floods of short duration. To bridge such a stream with a truss or high concrete bridge would be expensive, but would prove satisfactory if one could be reasonably sure that the river would continue to flow under the bridge. At flood time the stream usually spreads over the river bottom to such an extent that no kind of bridge would be accessible.

The expense of lengthening a high truss when the stream washes around the end of it, or when the stream chooses a new channel half a mile from the bridge, has led to the building of the cheapest possible types. Attention has been turned to low water bridges, and cheapness of construction has been thereby attained. Flood water passes over such structures and renders them impassable during the duration of the flood, which time amounts to not more than five days during the year.

Concrete Flat Slab Construction Adopted

Many failures have occurred with low water bridges, and both theory and experience have led to the use of a concrete flat slab supported by a light pier on wood piling. The standard used in this state is built in panel lengths of 20 ft., with expansion joints at alternate piers and five piles under each pier. Piling is driven to solid footing and is cut off below low water. There is no curb but provision is made for a cable railing supported on posts. Form work is handled at minimum cost since framing is often eliminated by supporting the slab forms of lumber or heavy paper directly on the sand.

Wood Construction Unsatisfactory

In rivers where the flood carries large amounts of draft, it is necessary to place the bridge sufficiently low so that the flood water will not only pass over, but will carry the drift above danger of lodging on the bridge. Wood construction has in general proven unsatisfactory on account of the difficulty of holding the floors, and practically all new work is of concrete. Several concrete bridges have been built from 100 to 400 ft. long, and there is now under construction a bridge 1,200 ft. long of this type.

As shown in the accompanying pictures, one of these concrete bridges was recently pushed slightly out of alignment by the drift which lodged against it during an unprecedented flood. The cause of this can be traced to the fact that the bridge is built too high. In this case not more than a foot of space should have been left between low water and the bottom of the slab. This occurrence demonstrates that flood conditions should be observed in each stream prior to construction in order that the drift carrying stage may be determined.

Concrete Low Water Bridges Are Satisfactory

The current at flood time in the streams is very swift, and as a result the sand in the stream bed is set in motion to a depth of 10 ft. or more. It is evident from this that the bridge itself which is at times covered with 8 or 10 ft. of water

LOW WATER BRIDGES ON OKLAHOMA HIGHWAYS.
Left: Upstream View of Concrete Low-Water Bridge after a Flood. Center: Downstream View of Same Bridge. Right: Wooden Floor and I-Beam Joists Were Carried Away by High Water.

must be heavy, firmly anchored, and must offer little surface to the force of the stream. Experience in this state has proven that the concrete low water bridge, properly located and built, can be depended upon during practically the entire year.

Recommended Practice in Design and Construction of Permanent Highway Bridges of Concrete and Steel

By John W. Towle, Government Representative, Emergency Fleet Corporation, Philadelphia, Pa.

Today there are but two generally accepted types of bridges that are suitable for permanent highways, and these are constructed of concrete and of steel.

The decision as to which of these two is best adapted to a given location is at times difficult to make, and is largely a matter of judgment. In a general way, however, the shorter spans should be built of concrete and the longer ones of steel, leaving the lengths between 24 and 60 ft. to be determined by individual conditions, said Mr. Towle, in addressing the North Carolina Good Roads Association.

Concrete Bridges

There are three general types of concrete superstructure:

1. The flat slab or box culverts, for short spans.
2. The girder, having two or more heavy stringers, running lengthwise for the middle lengths.
3. The circular or elliptical arch, for the longer bridges.

Flat Slab Construction

1. The first type consists of a flat slab of concrete, extending the full width of the bridge or culvert; having a thickness usually from 6 to 12 ins., depending upon the distance the supports are apart. Running parallel with the roadway and stretching from foundation to foundation, is a series of reinforcement bars ½ to 1-in. thick, usually 6 ins. on centers, and placed about 2 ins. from the bottom of the slab. These are supplemented with other reinforcing bars of smaller sizes at right angles, thus making a network of steel to tie the concrete together and to give the tensile strength necessary to carry the loads. The slab construction is rarely used in bridges over 16 ft. in length.

Girder Bridges

2. The girder concrete spans usually have from two to four stringers running lengthwise of bridge. Each girder has a width of from 10 to 14 ins., and a depth of from 12 to 36 ins., depending upon the length of the span, number of stringers, and capacity for which the bridge is designed. For the floor system a slab of concrete covers the entire bridge, resting over the stringers. The girders must be strongly reinforced near the under side with heavy steel rods from ¾ to 1½ ins. in size and in numbers sufficient to give the necessary tensile strength. This style of span can successfully be constructed up to lengths of 40 ft.

Arch Bridges

3. The arch is the natural type for concrete bridges, and is a modern development of the old-time arch that has been used for many centuries. By the proper use of reinforcing steel the quantity of material necessary can be greatly reduced, and a greater safety insured. It is desirable to have arches designed as nearly a half circle or a half ellipse as the height of the bridge will permit.

The arches are either solid or uniform, having a varying thickness at the center of 10 to 12 inches, and at the ends of about 14 to 18 ins., depending upon the length of the span, rise of arch, and strength desired. In many cases the arches consist of individual and separated girders, connected together over the top with a thin floor slab. At the sides of the bridge and above the arch are the spandrel walls, which hold the fill and pavement in place and form the base for the hand rail.

This style for the ordinary highway bridge usually runs from 40 to 60 ft., and in exceptional cases has been built up to 200 ft. in clear span. One arch over the Spokane River in Spokane, Washington, has a length of 350 ft.

One of the great advantages of the concrete bridge is that it has more or less fill over the span and permits of a continuous roadway pavement.

Bridge Foundations

As in all engineering structures, the foundation is of the most vital importance. The slightest settlement in a concrete span spells disaster. I have in mind one long bridge over the Illinois River at Peoria, where a settlement occurred in one pier; it caused a failure of an adjoining span; the pier being relieved of the balancing end-thrust was pushed out of line, causing the failure of the next span; and so on, one at a time, they fell into the river, making the complete destruction of a million-dollar structure.

A thorough test of the underlying strata must be made before an intelligent opinion can be formed as to the foundation necessary. A bed of gravel, a layer of hard, dry clay, or a stratum of shale or rock, will usually suffice. This can be easily reached, if below water, with the aid of a cofferdam built of boards or plank properly lapped. After the bed is thoroughly cleaned of all loose and soft material, the footings of concrete are poured.

Should the desired location for the bridge bring the supports where there are no solid strata, then it becomes necessary to make an artificial foundation, and this is most commonly done by driving wooden, concrete, or steel piling. The length and number are determined by driving tests and computing with engineering formulas, having as known quantities the weight in tons of the structure itself, and the desired capacity for which it has been designed.

In some of the longer spans, where special cases seem to demand them, steel tubes from 6 to 12 ft. in diameter are sunk to a firm foundation and filled with piling and concrete.

Wings and Spandrel Walls

Next in importance to the foundations and the superstructures of concrete bridges are the wings and spandrel walls. When properly designed and constructed, they retain the fill over the span and in the approaches, making it possible to have a solid roadway of full width, up to and over the entire structure. The place of greatest danger about a bridge is always at the approach, and this gives us a further reason why these parts should have special attention.

Upon the top of the spandrel walls is built the railing. This can be of varying form and material to suit the artistic demands of the community.

Concrete Mixtures

The mixtures for the different parts of the bridge can be varied somewhat, if you take into consideration only the strength desired. It is the best practice, however, when by the addition of a small amount of cement a more permanent and lasting concrete can be made, to add it. It is false economy not to go to this small extra expense in outside concrete work.

The superstructures, the slab, the girders and the arch, take the greater strains, and should have perhaps the richest mixtures; the standard being for them, 1 part cement, 2 parts sand, and 4 parts stone or washed gravel. The wings and spandrel walls, acting as they do more as retaining walls, should have a mixture not weaker than 1, 2½ and 4½. The mass concrete in the foundations, where even less strength is required, can have the proportions of 1, 3 and 5.

Quite often when streams are shallow and their banks low, and the roadway but a few feet above the surounding land. it becomes quite a problem to get the necessary waterway. The arch type must have a considerable rise in order to attain full strength. The girder presents less of a side wall

to the floods and is often substituted for it, even beyond its economic length. So it frequently becomes necessary to give up entirely the idea of a concrete span for a steel design because of the lessened bulk and the corresponding reduced obstructions to the flow of water.

Steel Highway Bridges

We have but two types of highway steel spans in common use—those utilizing the Pratt truss and the Warren truss. The Pratt truss is perhaps the simplest, the most economical and the most satisfactory for highway purposes of any that has ever been developed. It has straight horizontal top and lower chords, the former in compression and the latter in tension, with intermediate posts in compression and hangers and long diagonal members in tension. These bridges can have either a low truss or a high truss, the latter having an overhead system of braces above the roadway. In length the low trusses are usually from 24 to 100-ft. and the high trusses from 80 to 400-ft.

This type of span can have many variations, such as the half-hip for short spans; thus the inclined top chord, the double intersection, the subdivided panel for the long spans. There can be either deck or through trusses, and both pin-connected and riveted bridges. In fact, having such simple lines, so easy of computation and analysis, and so economical in its design, it stands out today as the one type of bridge most satisfactory to the engineer.

The Warren truss is used quite commonly in rivet-connected spans of shorter lengths; but principally in low trusses; rarely in bridges over 80 feet in length. A few high trusses have been constructed of the Warren type, but on account of the long diagonal members being in compression, it makes an unsatisfactory design, and is contrary to the best engineering practice.

Difficult locations involving complicated erection problems often require special designs: for instance, in places where it is impossible safely to erect false work it is quite common to select an arch or cantilever truss which can be erected by balancing each increment of steel until it closes in the center and becomes a continuous and a complete structure.

Foundations

The best foundations for steel bridges are concrete with the seats for the shoes reinforced. The piers or abutments should rest on solid strata the same as in the concrete bridge, or else piling should be driven to a firm and substantial footing. Quite frequently steel tubes 3 to 6 ft. in diameter are settled into place, never less than 6 ft. below any possible wash, with piles driven through the bottom deep into the river-bed. Concrete is then poured about the head of the piles and the tube completely filled. Each shoe of the truss sets on one tube, thus making a very satisfactory support.

Floor Systems

For hard surface roads and well traveled highways, nothing but substantial and permanent floors should be constructed. Either concrete floor slabs, spanning from beam to beam, should be used, or else steel joist, with a concrete covering. This concrete should be strongly reinforced and made in the most careful manner of not less than a 1, 2, and 4 mixture. These floors should be so joined to the abutments as to provide a perfectly smooth connection with the roadway at each end of the bridge; as in concrete spans the wings and approaches are of great importance, for they serve to maintain a safe and satisfactory roadway up to and over the structure.

Rules to Observe in Bridge Building and Maintenance

1. Be sure and build the foundations high enough, so that the floor system of the bridge will be above any known high water.

2. Always carry the foundations at least 6 ft. below any future wash in the bed of the river.

3. See that the design of the wings and backing at the end of the bridge is such as to maintain a permanent approach fill.

4. The steel of the spans should be thoroughly scraped with steel brushes, and painted at least once in every three years.

5. Cracks due to settlement or expansion in concrete structures, should be carefully repaired once every year.

6. In deciding upon the kind and length of a new bridge for a given location be sure to compute carefully from the area of the watershed the flood waters that must pass under the structure.

7. Never build a bridge with less than 16 ft. of roadway, and it would be much better to make it 18 or 20 ft. so as to have sufficient width for the passing of vehicles.

Conclusion

The nation's highway system is the foundation of its whole vast and complicated machinery of transportation. The public highways are indispensable, and they should be kept in condition. Money must be spent and labor and material must be used *now*. In many of the Eastern States the army truck has partially destroyed the highways; so the maintenance should go on uninterruptedly or the tax-payers of the country will have to pay an enormous bill for their restoration after the war. Their present value in terms of service rendered is literally incalculable, for without them every activity would have to cease.

Prove That You Are a 100 Per Cent American

Today it is an honor to say: "I am an American." When you see a boy in the U. S. khaki, or a blue-jacket from our Navy, it makes you proud to say, "I am an American." When you read of the heroic acts of our boys on the fighting front it makes you thrill when you think, "I am an American."

You have the right to say that if you are doing your share; if you are obeying cheerfully the laws and regulations made necessary by the war; if you are learning to speak the language of America, or helping others to learn it; if you are a citizen or preparing to become a citizen of America; if you are backing the Liberty Loan with every dollar you can possibly invest—then you have the right to say with pride, "I am an American."

Buy Liberty Bonds.

A Motor Operated Masonry Surface Rubbing Machine

To meet the demand for a speedy machine with a good range of action for rubbing and polishing side walls, columns, bridges, subways, etc., the Cavicchi Polishing Machinery Co., of Quincy, Mass., has developed a portable motor operated machine equal to ten manual workers, it is claimed.

The rubbing wheel is on a jointed arm and has a radius of action of 6½ ft. vertically from the floor and 8 ft. horizontally. The rubbing wheel and the water pump to eliminate dust, are driven by a motor made by the General Electric Company.

Springs in the arm, counteract its weight and keep the carborundum wheels of the various kinds suitable for the different classes of work pressed against the wall regardless of its irregularity. An ample supply of water is provided by a reservoir in the body of the machine.

REFUSE COLLECTION AND DISPOSAL

Effect of War Conditions Upon Production and Disposal of Municipal Refuse

By Rudolph Hering, D. Sc., Consulting Engineer, 170 Broadway, New York, N. Y.

The war conditions in this country have had quite a number of noticeable effects upon many of our engineering activities, among which is the effect upon the production and disposal of municipal refuse. The general effort which we are all making to economize in our food and urging its most complete utilization, the frequent signs, "Food Will Win the War—Don't Waste It!" have had a substantial result in the decrease of the usual quantities of garbage in many of our cities. Also such rubbish as waste paper and leather have here and there decreased, and the shortage and greater cost of coal may also reduce the usual amount of ashes. These results are of interest and value in several directions.

American Extravagance

They emphasize most prominently our American extravagance. Every European country has had less municipal waste than we have, as comparative figures in the per capita production, particularly of garbage and rubbish, indicate. In European cities there has nowhere been enough grease left in the garbage to pay for its special extraction, while here most of the large cities have made its extraction a profitable business. In Europe the picking over of the rubbish had been almost everywhere condemned and abandoned some half dozen years ago, while here despite our higher wages, picking over is still practiced in some cities.

Will not our natural evolution gradually increase our economical sense to the standard of Europe? Will not perhaps the present enforced effort of greater economy open the way to it? There is, I believe, every indication that we, as a nation, will be less extravagant in the next generation than we have been in the past. Our enormous war debt must be paid. Our labor cost will no doubt remain higher than that in Europe, making world competition in manufactured articles no less difficult than heretofore, realizing that labor-saving machinery will be as common in Europe as it will be here.

Need for Greater Economy in Wants and Greater Skill in Production Methods

To reduce the inevitable effect of these prospects, there seem to be two solutions. One is the exercise of greater economy in our daily wants, approaching the European basis, and the other is the exercise of greater skill in our production methods. They will have to be obtained by a more thorough education and better training, so as to make the net result and useful return from a day's work go further than heretofore.

Will not then also the diminution of waste naturally be one of the first points to attack? Consequently we shall endeavor to utilize whatever can be profitably saved at our homes. We shall ascertain the greatest value inherent in whatever we personally no longer require and endeavor to realize such value elsewhere.

Garbage Utilization

Let us take garbage as an example. It is produced by the rejection of those parts of our food materials which are undesirable or unfit for us to eat. This garbage today when it is fresh has its greatest value for hog feeding. When it is partly decomposed it has a lesser value, derived only from the grease that can be extracted from it and the fibrous residue which can be used as a filler for high-grade fertilizer or as a fuel.

Therefore, we should first try to recover its greatest value and collect garbage daily and use it fresh as animal food, wherever conditions allow this to be done. We must adopt the best practicable methods for prompt collection in clean wagons or trucks and have well designed, clean and easily accessible feeding places.

Feeding the Preferred Solution

Under favorable conditions feeding will unquestionably be the preferred solution for most of our cities in the future on both economical and sanitary grounds.

Where feeding is not practicable, then, for instance, in large cities, excepting hotels and eating houses where feeding may remain most profitable, works for grease extraction may remain as the next profitable means of utilization. When our citizens become as economical as those in Europe and reject only a very small amount of grease, then either burial, as in Berlin, or incineration, as in England, would be in order.

We have already had difficulty at reduction works with tin cans and corn cobs. They yield no grease and cause a lot of trouble. It is, therefore, suggested that cans and husks be picked out and separately treated. Water melon rinds may come next.

Regarding the rubbish in war time, it is questionable whether the higher prices obtained from reclaimable materials will on an average pay for the higher war-time wages. Even if it would pay it is questionable whether the medical profession will not eventually find a serious objection to picking over rubbish, some of which might include rejected beds, clothing, rags and sweepings from sick rooms.

Garbage Utilization Work of the United States Food Administration

By F. C. Bammar, Garbage Utilization Division, U. S. Food Administration, Washington, D. C.

The United States Food Administration is undertaking investigations in the larger cities utilizing their garbage to determine three main points:

1. The amount of edible food finding its way into the garbage pail.
2. The extent and nature of foreign materials being placed with the garbage and interfering with its utilization.
3. The extent to which garbage is burned or otherwise destroyed.

In each instance corrective measures are also being developed and the educational campaign is being intensified. Of course cities not utilizing are being urged to undertake utilization methods and every possible assistance is being offered such cities.

The educational campaign mentioned contemplates the use of garbage as hog feed or through reduction plants. The fundamental object of the campaign is to persuade the housewife to keep her table and kitchen refuse free from tin cans, bottles, broken crockery and other foreign materials and to see that it is utilized after it leaves her door.

Data on Garbage Utilization

One Ton Garbage Will Produce:

1. Sufficient glycerine for the powder charge, as nitroglycerine, of 14 75mm. shells.

2. Sufficient "fatty acid" for the manufacture of 100 12-ounce cakes of soap.

3. Sufficient fertilizing elements to replace the nitrogen, potash, etc., taken from the soil by the growing of eight bushels of wheat.

Value Recovered from Garbage in 29 Largest Cities

Twenty-nine of our larger cities are disposing of their garbage by the reduction process. Their combined population exceeds 18,000,000. From the garbage of these cities is obtained the following:

Estimated grease production.....72,000,000 lbs.
This amount of grease will produce 10,000,000 lbs. of nitro-glycerine, enough for the powder charge of about 16,000,000 of the French 75mm. shells. The fatty acids contained are sufficient for the manufacture of about 200,000,000 12 oz. cakes of soap.

Estimated fertilizer tankage production.....150,000 tons
This amount of tankage contains about 9,000,000 lbs. of nitrogen, 2,000,000 lbs. of potash, enough to replace the nitrogen and other elements taken from the soil by 8,000,000 bushels of wheat.

Estimated value on June 15, 1918, of the above amounts of grease and fertilizer tankage.....$11,100,000

Utilized Garbage Values in Some Cities

In practically all of the above cities large amounts of garbage are destroyed by burning or made useless by being mixed with other wastes. The total amount of such unutilized garbage is estimated as sufficient to produce the following:

Estimated grease wasted.....9,000,000 lbs.
This amount of grease will produce about 1,300,000 lbs. of nitro-glycerine, enough for the powder charge of about 2,000,000 75mm. shells; fatty acids sufficient for the manufacture of about 25,000,000 12 oz. cakes of soap.

Estimated fertilizer tankage wasted.....22,500 tons
This amount of fertilizer tankage contains about 1,250,000 lbs. of nitrogen, 3,500,000 lbs. of phosphate of lime and 350,000 lbs. of potash, enough for the replacement of the elements removed from the soil by 1,000,000 bushels of wheat.

Twenty-four Large Cities Not Utilizing Garbage

Twenty-four cities of over 100,000 population are not utilizing their garbage. Their combined population exceeds 5,000,000. This means that the following is lost:

Grease, estimated at.....30,000,000 lbs.
This amount of grease would produce 4,400,000 pounds of nitro-glycerine and 40,000,000 12 ounce cakes of soap.

Fertilizer tankage estimated at.....60,000 tons
This amount of tankage contains fertilizer elements sufficient to grow a 3,000,000 bushel crop of wheat.

Estimated value on June 15, 1918, of the above amount of grease and tankage.....$5,000,000

Pork Production from Garbage

One Ton Garbage Will Produce:

100 lbs. of good, firm white pork.

Three hundred of our cities of over 10,000 population are disposing of their garbage by feeding to hogs. Their combined population exceeds 9,000,000. Their garbage would yield the following:

Estimated pork production.....100,000,000 lbs.
Because of poor separation, inedible materials in garbage, losses, etc., the amount of garbage fed pork actually marketed each year is about 50,000,000 lbs. This would have a value of over $8,000,000.

Group of 350 Cities Not Utilizing Garbage

Over 350 of our cities between 10,000 and 100,000 population are not utilizing their garbage. Their combined population exceeds 6,000,000. The utilization of their garbage would yield the following:

Estimated pork production.....60,000,000 lbs.
Probably the feeding of the garbage produced by these cities would only add from 30,000,000 to 40,000,000 lbs. of pork, valued at about $5,000,000.

PAVEMENT CLEANING AND MAINTENANCE

Preservative Effects of Macadam Surface Treatments Applied Primarily as Dust Layers

By F. S. Krug, Chief Engineer, Engineering Department, City of Cincinnati, Ohio

The oiling of streets in Cincinnati was considered at first as primarily a dust laying measure, and was advocated as a method superior to sprinkling, both on account of its comparatively permanent results and on account of the destructive action of the constant wetting of a macadam road surface, and it was not until streets had been oiled or treated during successive years that its value as a preservative became apparent.

Large Mileage of Macadam

The city of Cincinnati has a very large mileage of macadam (approximately 281 miles) out of a total of 576 miles of improved streets, based on a uniform width of 30 ft., and a very large proportion of these macadam streets has been treated with oil or some other preservative.

It seems needless to go into the merits of these surface treatments as dust layers, as there is no question of their efficiency for that purpose, and their superiority over the old method of constant wetting is so marked, and the destructive action of water on a macadam surface is so well known, that it is doubtful if sprinkling of a macadam surface should be permitted.

We come then to the other action or result of oiling, namely, its preservative action, and this cannot be treated separately from the other preservatives, such as tar products and liquid asphalt, each of which seems to have its particular qualities and merits.

The proper consistencies of tar and asphalt products for surface treatments are quite well known, but this is not true of road oil. There are many grades of oil in use, all of which are (to a more or less extent) dust layers, but I believe it inadvisable to use anything less than a 50% asphaltic content oil, and I prefer a 60% unless the street surface is subjected to light traffic and has had several annual treatments, in which case a 50% oil might be used to advantage.

In the annual report of the Division of Street and Sewer Repair for the year 1917, submitted to me by Mr. C. L. Harrison, Engineer in Charge, Mr. Harrison writes as follows:

The Preservative Effects of Surface Treatments Applied Primarily as Dust Layers

The macadam street area which is annually treated with oil, tar or asphalt products for the purpose of dust laying has shown a marked increase during the last few years, and the effect of these treatments as preservatives

(aside from their primary purpose of dust laying) is becoming more marked each year. Those streets which have had several annual treatments seem to have changed their character and to have taken on characteristics other than those of water-bound macadam streets. The change is so marked that it would almost appear as if a new type of pavement has been created. The effect of these annual treatments on maintenance costs is quite evident and indicates a marked decrease in expenditure, as it is a comparatively easy matter to maintain such a street in good condition by the "Bituminous Patching Method," and the life of such a street is undoubtedly prolonged out of all proportion to the cost of such treatments.

Correcting Disadvantages

There seems to be very few disadvantages connected with the application of surface treatments, and these can be corrected by proper care in the prepaartion of specifications and proper inspection for adherence thereto. The greatest difficulties seem to be incident to the fact that macadam street surfaces are not uniform in texture, due to the comparative recentness of construction or repair, to the number and frequency of previous treatments, to traffic conditions and to the character of material used in the construction and repair. These conditions must be taken into consideration in making up specifications, as the amount of oil, tar or asphalt necessary to treat the street properly is directly dependent on the porosity of the street surface, but this can be regulated by taking bids on a sliding scale of amounts of material per square yard.

Most Important Factors

I think that the most important factors in obtaining a good treatment are, first, a thoroughly clean, hard street surface; second, proper weather conditions at the time of treatment; third, accurate selection of the most suitable material, and the applying of the proper quantity; and, fourth, thorough sanding with shot gravel after the treatment.

The value of these treatments is becoming increasingly evident, and they may become almost universal where the proper materials are available.

Procedure in Maintenance of Asphalt Pavements in Buffalo

By C. E. P. Babcock, First Assistant Engineer, and J. A. Vandewater. Assistant Engineer in Charge of Repairs, Department of Public Works, Buffalo, N. Y.

With the expiration of guaranties of the first asphalt pavements and the assumption of repairs by the city out of its general fund, a detailed record was entered and carried on. Having had no experience in the cost of asphalt repair and little, if any, information being obtainable in this country, it was perhaps as much an engineer's curiosity or wonder, rather than a pre-determined appreciation of the magnitude and importance of knowledge of cost of future repairs, which developed our present method of recording.

Records of Costs

From printed reports the cost of each street, each year, can be ascertained. As the life of asphalt pavements in Buffalo is (with few exceptions) 20 years or over, these records have assumed a considerable volume and the question arose as to whether their value justified the space and the cost of printing year after year.

Fortunately it was decided to continue the record, leaving off the early details and publishing the area and cost in detail for 10 or more years back.

As example:

Cost of repair before
1910————Total and rate
Area, cost and rate since
1910 in detail, Annual

This seems to have satisfied the objection, and probably this method will be continued.

These tables are beyond the interesting stage and have become a necessity, and are more referred to than many other mere tables, for this reason: the question always arises as to whether a street has received an adequate repair, whether the city should carry it on. As two-thirds of repaving is assessed, of course the local desire is to postpone the local expense regardless of the engineer's advice. These tables, showing yardage and cost of repair, form a basis for argument and determination. Beside this we locate and plot on cross-section paper every patch repaired, using different colors for each year. These plottings show, not only the yearly repair, but more important, where repair overlaps previous repair. The contractor guarantees his work from December 31 of the year in which they are made for one year. Therefore, if a repair is made over-lapping the joint of a repair under guaranty an allowance of 6 ins. is made and not charged to the new guaranty.

Basis of Repair Contracts

Heretofore our contracts were made on the basis of a square yard repaired. For our resident asphalt contractors this seemed a fair basis because, after experience, they knew about the amount of the season's work and the material required for it.

In 1908 our investigation showed that of the original depth of the asphalt, viz: 1½ ins. of binder and 2 ins. of wearing surface about 52% depth binder was used in repair and about 82% top (see 75 and 78% later on).

If an outside company wished to bid on the square yard basis they would not have had this experience. With our own knowledge of the conditions we felt that our contract should be made on something different than the square-yard measurements for the materials used. It is of course known by the engineers and contractors that the binder costs less per cubic content than the wearing surface.

While there probably was not a pre-fixed idea of the contractor when his bid was submitted, that he could manipulate the use of the binder and top to his advantage, yet the opportunity was there, and in a city contract an opening of that kind is open to criticism if not something worse.

Provisions of Specifications

Therefore, after collecting the data available, the Department of Public Works authorized a new specification, the principal factors in which are that:

Both top and binder are purchased at the plant of the contractor by cubic measure, the price including delivery on the work.

The asphaltic cement for painting joints is paid for by the gallon delivered.

The cost of the street work includes labor, the chopping out of patches, laying material and cleaning up. This we pay for by the square yard.

Our contract also provides for relaying concrete base, unless the city performs the work with its own force.

Also for paving in trenches with binder 1½ ins. deep and top 1½ ins. deep and labor—a price being bid

For trenches under 80 sq. yds.

For trenches between 80 and 480 sq. yds.

For trenches between 480 and 1000 sq. yds.

For trenches over 1000 sq. yds.

If two or more trenches of this kind are within one-half mile one from another and are repaired as a continuous work, the sum of their areas is the area on which payment is made.

By this specification the city uses all of either the binder or the top as its engineer requires and pays for the amount actually used. Our specifications quote that the average depth experience was for binder 1.12 ins., top 1.57 ins. or 75 and 78% of original depth, and this definition we make for the information of the bidder.

In the 1917 work we found that we used about 0.87 in. average depth of binder and 1.57 in. of top, or 58 and 78% respectively. The reduction in binder is partly due to the fact that our pavements are becoming thin. Those laid prior to 1912 were laid on ½ in. cushion instead of binder, and these require little, if any, binder in repairs. Our specifications provide that when the old pavement is less than 2 ins. deep binder shall not be used for repair.

Bids for repairs are received early in the calendar year, giving the contractor time to order his material and to arrange his organization.

As soon as the weather permits, usually in March, an inspection of all pavements is made, conditions are noted, and a list of streets to be repaired is prepared, streets in the downtown or business section and the principal thoroughfares being taken care of first. We endeavor to repair all our asphalt pavements at least once a year and this has been done with a few exceptions. Pavements that have unusually heavy traffic are repaired twice a year when necessary.

Work is begun about April 1 and usually continues until about December 1. The pavements to be repaired are marked out by what we term an Asphalt Locator, who is assisted by boys who measure up and locate the patches and a man to record same in field book. The contractor also furnishes a man to keep a record of the size of the patches, and his records must correspond with those made by city's locator. The repair gang then follows, chopping out, relaying the new material and cleaning up; a gang laying from 750 to 1000 sq. yds. per day depending upon the size of the patches. All old material is the property of city and removed to dump provided by contractor or wherever the engineer may direct.

Quantities and Costs

The work is done by two large gangs consisting of about 75 to 100 men each, foremen, teams, trucks and rollers. There is also a small gang employed repairing cuts made by the Bureau of Water, plumbers, corporations and others, and two gangs where necessary.

During the last 15 years or up to June 30, 1917, about 3,000,000 sq. yds. of asphalt pavement have been maintained annually; the greatest number of square yards being 3,139,731 in 1911 and the least 2,858,634 in 1916.

The average cost per square yard on total yardage maintained has varied from $0.0162 in 1903, due to the small appropriation available for this purpose, to $0.0827 in 1913; the average for the last 15 years was a little over 5 cts per square yard. But this rate does not represent the necessity of repair which the department might recommend, but is influenced by the funds available. The last 5 or 6 years the appropriation for this purpose has been very fair.

The contract price has varied from 74 cts. to $1.39 per square yard laid up to Dec. 31, 1917, and on account of the high cost of labor and material this year, the rate may run somewhat over $1.80 per square yard laid.

Up to June 30, 1917, $2,899,781 has been expended on repairs to asphalt pavements. The average rate per square yard in area of the streets repaired being $0.0653 and on the area maintained $0.0451.

Cutting Out Patches

In 1917 a gas-driven cutting machine was devised by one of the contractors to cut out patches, action similar to that of a pile driver. It is not altogether satisfactory, particularly on old pavements where it often breaks contiguous pavement. Our experience is not sufficient to warrant an extended criticism. A rather specious argument for its use is that it acts as a sort of balance wheel for labor and axes, when the labor looks for higher wages; but for good workmanship we have not found a mechanical cutter that compares with a man and axe.

It should be recognized that additional life is added by making adequate repair.

It is perhaps not possible to establish an exact relation between the advisable expenditure on repair as compared with the life of a pavement, because of the variables: 1st, cost of labor and material; 2nd, continuation of proper maintenance; 3rd, increase or change in traffic.

A total of 64,300,000-year-yards repair of paving, carrying 5-year guaranty prior to 1898 and 10-year guaranty on pavement laid since 1898, show an average annual rate of $0.045 per square yard. The present average age of all asphalt pavements under city maintenance is about 21.7 years.

The foregoing is a paper presented before the recent convention of the American Society of Municipal Improvements.

Data on Performance of Motor Apparatus Operated by Bureau of Streets, Buffalo, N. Y.

By William F. Schwartz, Street Commissioner, Buffalo, N. Y., in Address to American Society of Municipal Improvements

The city of Buffalo at the present time has two Elgin motor sweepers. These sweepers were bought and placed in operation on Oct. 1, 1916, replacing six horse-drawn sweepers and two sprinkling wagons. They work two shifts, 8 hours each per day, namely, 3 a. m. to 11 a. m. and 4 p. m. to 12 p. m. They are a combination sprinkler, sweeper and pick-up, being equipped with a 200-gal. tank, large circular broom and 1½-cu. yd. box. The motor power is a 45-h. p. engine.

During the past year three motor street-flushing equip- approximately 72,000 great squares (a great square consists of 10,000 sq. feet). We find they did the best work on smooth pavement, and that the cost per great square was about 2c lower than in horse-swept districts. On account of the abnormal times we have had considerable trouble in getting competent drivers, consequently the machines have not been worked as satisfactorily as under normal conditions.

During the past year three motor street-flushing equipments were installed by the department to replace the old method of flushing and, in some districts, street cleaning.

The Equipment

In constructing and designing this equipment the department took into consideration—1st, cost of equipment; 2nd, length of time of service; 3rd, operation and maintenance; 4th, size.

From the above we specified a five-ton tractor with power-take-off from transmission to pump that delivers pressure for flusher; a trailer with 2,000-gal. tank capacity set upon the fifth wheel on tractor. Tractors in operation are the five-ton Pierce-Arrow of standard design, with exception of power take-off of 15 h. p. and are geared 42 to 1. The tractors are equipped with dual 36-in. tires rear and single front.

The trailers and pumps are manufactured by Chas. Hvass & Co., of New York City, and are provided with cylindrical tank, four nozzles which are controlled from driver's seat, centrifugal pump driven from power take-off, also controlled from driver's seat. The pump creates a pressure of 35 lbs. (this pressure can be increased or decreased). We find that 35 lbs. will not injure the pavement and at the same time does cleanly work. When the street is very dirty we use the four nozzles, which gush 525 gals. per minute, but as a rule we only use two nozzles which flow 150 gals. per minute. During the process of flushing, the tractor runs at a speed of 4½ miles per hour, running empty 14 miles; weight of tractor and flusher when full 18 tons, when empty 10 tons.

Use of Equipment in Snow Removal

During the winter season the trailers are removed from tractors, and the tractors are placed in operation in snow work, also hauling trailers for ash and garbage districts. We estimate during the past winter that these three tractors saved the city at least $15,000 in snow work alone. A great many of our streets in the outlying districts became drifted

and it was an utter impossibility for the city to get labor to remove it, notwithstanding the fact that we placed every available prisoner which we could commandeer from the penitentiary. We equipped the tractors with Good Roads snow plows and found they did excellent work.

Operating Costs

The cost of operation per day (which includes operating charges, maintenance and fixed charges) for a 16-hour day we found to be $24.96; during the winter months this cost increased $2 per day on account of more gasoline and oil being used by being forced to run low gear the greater part of the time on account of bucking heavy drifts of snow.

Under the old system of flushing with portable line hose the cost per great square for 10,000 sq. ft. was $1.40. We experimented with the two-man reel (used in New York City) and found the cost to be 56c. The motor equipment reduced the cost to 20½c per great square; this includes everything, such as operating labor, supervision and pick-up wagons.

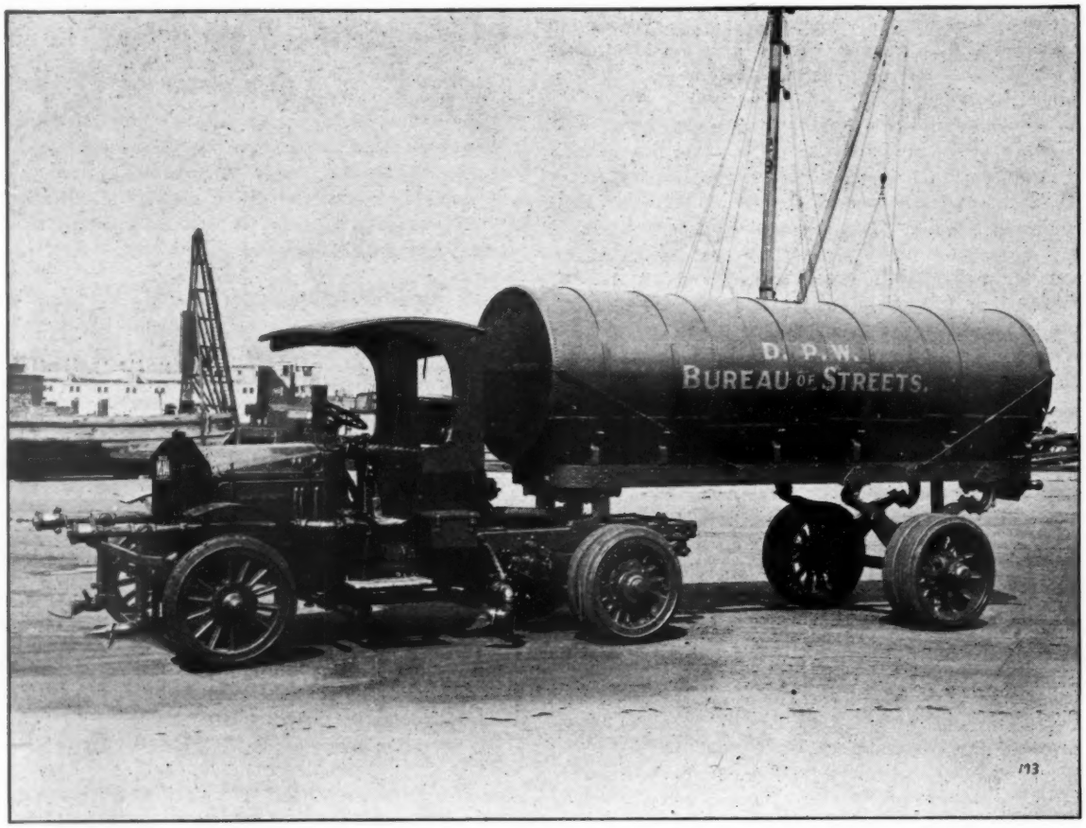
The city has contracted for three additional flushers, and it is the intention of the department, as soon as financial conditions warrant, eventually to do away with all horse-drawn sweepers and sprinklers and flush the entire town with the exception of cobblestone and macadam pavements, as we find the cost per great square for sweeping is $0.278 and that of flushing is $0.205. Motor equipment is not only more economical than horse-drawn equipment but leaves the streets in a more cleanly and more sanitary condition.

Motor Equipment in Ash and Garbage Division

For two months we demonstrated with trailers and tractors in the Ash and Garbage Division and found we could cut the expense approximately 25%, also getting greater efficiency. The system followed in the demonstration was to start empty trailers drawn by horses from various barns to the different districts. When these trailers were loaded tractors with a train of four empty trailers dropped the latter and took up the loaded trailers and proceeded to the dump or reduction plant, continuing this operation until the districts were cleaned up.

At the present time we have six Ford motor trucks in operation in the Ash and Garbage Division. These trucks have a capacity of 4 yds., but have only been in operation for four months, consequently we cannot get a definite line upon the maintenance and depreciation. The class of drivers we are able to get are inexperienced (being mainly boys of 17 to 19 years of age) so that these trucks are often laid up for repairs. In the writer's opinion this form of truck is too light in weight for collecting ashes, for the reason that the dumps through which they have to go have a tendency to jar the entire machinery badly on account of their light construction.

It is the intention of the department, after we have won the war, to motorize the entire Ash and Garbage Division.



MOTOR FLUSHING AND SPRINKLING UNIT OPERATED BY BUREAU OF STREETS, BUFFALO, N. Y.

Relative Efficiency of Methods for Repairing Bituminous Macadam and Bituminous Concrete Pavements

By George H. Biles, Acting Chief Engineer, Pennsylvania State Highway Department, Harrisburg, Pa.

In recent years there has been marked development in the methods of repairing and rehabilitating bituminous pavements. There are innumerable instances where pavements had apparently arrived at a stage of such failure that their entire reconstruction seemed justifiable, but by the scientific, efficient and economic methods of the Highway Engineer they have been repaired.

Bituminous Macadam Pavements

Bituminous macadam is represented principally by the penetration method types of pavement. Before taking up the efficiency of the actual methods of repair, some of the fail-

ures and causes of disintegration common to these types of pavement will be described briefly.

Causes of Disintegration of Bituminous Macadam Pavements

The most common deficiency in this type of work is found in the non-uniformity of the surface.

Raveling

As an example, we have first a section of road where the surface is composed of spots of excess bituminous material and bare or lean areas where the binder is lacking in quantity, which condition results in a short time in a raveling or breaking up of the road surface. This condition is usually caused by improper distribution or by incorporating the bituminous material when the stone is not thoroughly dry.

Pot Holes.

Second—A rough surface is presented where the stone is loosened or raveled, the binder showing rapid deterioration, generally causing a series of pot holes. This may be occasioned by improper or overheated bituminous material, unsatisfactory aggregate or faulty sub-drainage.

Insufficiency of Bituminous Material

Third—At times we have apparently a lifeless surface insofar as the bitumen is concerned, but upon further examination it is found to contain bituminous binder with considerable life a slight depth below the surface. This condition is due in many cases to an insufficiency of bituminous material.

Excess of Bituminous Material

Fourth—A pavement may present a wavy and uneven appearance and this is usually due to an excess of bituminous material or is caused by the bituminous material being too soft to withstand the action of traffic.

Improper Pouring

Fifth—There are surfaces which consist of ridges of material which are the result of irregular or improper pouring—in most cases, careless hand pouring. A surface of this kind suffers quickly from the impact of traffic and the attack of the elements and early disintegration is the result.

Sixth—We have a fairly well shaped, uniform surface becoming porous. This condition is true of all bituminous highways in time as it represents the beginning of the deterioration of the bituminous material.

Method of Repairing Bituminous Macadam

Taking the several condiitons in the order mentioned, the first case, if taken in time, can be repaired by sealing the dry or lean spots in the surface with a light, heated application of bituminous cement of the binder grade, or the cold bituminous surface treatment materials in quantities ranging from 1-10 gal. to ¾ gal, to the square yard of surface, covered with chips or pea gravel, using between 15 and 20 lbs. to the square yard. Unless the surface is worn badly, repairs of this character will even up the surface to a true cross-section, giving added life to the pavement.

Scarifying and Harrowing

The second condition calls for heroic treatment if of any great extent and a complete scarifying and harrowing of the surface becomes necessary. All disintegrated material must be removed and sufficient new stone added to give the required depth before the surface can be repenetrated and sealed as in the original construction. If, however, the affected portions are only occasional and do not represent the greater area, they may be cut out, cleaned thoroughly and filled with new stone, making due allowance for compression, then penetrated, etc., in the manner hereinbefore mentioned. If drainage conditions are responsible for the failure, they must be corrected before any surface repairs are taken up.

Filling Surface Voids

The condition described in the third example may be treated in two ways. The most economical, so far as first cost is concerned, would be to give the pavement a treatment in sufficient quantity to fill the surface voids, with a material that will penetrate and enliven the old material, followed by a covering of good, hard stone chips, using about 20 lbs. to the square yard. The alternative would be to scarify and harrow the whole surface, supplying additional new stone in quantities as the rolling would indicate it to be required to give the proper cross-section, and penetrating the surface with a bituminous binder, sealing again as in the original construction. In the latter method, the surface must first be thoroughly cleaned and in scarifying and harrowing, the remaining bituminous material in the road must be distributed as evenly as possible. If the material found in the pavement, however, does not possess life, this method is a hazard.

Reshaping Surface

In the wavy, corrugated surface, where there is found to be an excess of bituminous material, it is generally more economical and satisfactory to scarify and reshape the surface, adding new stone in order to take up the excess bitumen, and again sealing the surface. This same method should be followed where waves have been caused by the bituminous material being too soft only, perhaps, more stone would be required in the reconstruction and it would be essential to incorporate a harder bituminous binder than was used in the original construction.

Occasional waves in the surface may be taken out in the due course of ordinary repairs by cutting off the high places and resealing, if the conditions are very pronounced, or by cutting out the depressions and replacing with new material.

Painting Between Ridges

A surface full of ridges due to improper pouring, if not too pronounced, may be evened up by painting between the ridges with bituminous cement and covering with stone chips or gravel. This method may be continued from time to time until the surface is entirely evened up. This condition may also be corrected by scarifying the surface with the object of obtaining a more uniform distribution of the old bituminous penetration pavement but the bituminous material is applying a surface treatment of a cold bituminous material that will enliven the existing material and seal the surface. This treatment is covered with stone chips in the manner prescribed for regular bituminous surface treatment work.

Applying Seal Coat

In the last case, we have a properly constructed bituminous penetration pavement but the bituminous material is starting to deteriorate. This can be enlivened or revived by cleansing the surface and applying a seal coat of material in quantities depending upon the degree of disintegration. Caution should be exercised to avoid applying an excess amount, which results in a slippery condition and is very objectionable to horse-drawn traffic. Generally 1-10 to 1-6 gal. is used and brushed into the surface with hand brooms. The surface is then covered with chips or gravel approximating 20 lbs. to the square yard. In the use of certain slow drying cold bituminous materials it will be observed that the new material softens up the old bitumen somewhat, giving the appearance at first of an excess application, and, having a hard surface underneath the road becomes quite slippery, but this condiiton obtains for only a short period of time.

To insure the best results, one-half of the road should be treated at a time in order that the traffic may use the other portion while the bituminous material is setting up. This method has become quite effective and results in increased life to the pavement.

Hot Bituminous Binders

In the repairs of breaks, depressions and local defects,

which may occur under any one of the general conditions previously outlined, it is more satisfactory to use hot bituminous binders, and if replacements are necessary they can be made after the fashion of the original construction. This work can be done very efficiently in this manner with little equipment and the average class of labor. There are a number of instances where cold bituminous compounds can and are being used successfully in certain seasons of the year on pavements of this kind, but in cold weather there is usually difficulty with some of this material, owing to its composition. As an example, the emulsified products break down or separate and their adhesiveness is destroyed at low temperatures. Materials that are cut back with natural solvents can be used later and give very good results. The mixtures can be prepared at some point not exposed to the weather but convenient to the work, hauled to the site of the repairs, and deposited. This is an effective method in case of emergency.

Bituminous Concrete Pavements

The various mixed bituminous pavements, with the exception of sheet asphalt, are included in the class of bituminous concretes. Different streets, in spite of the fact that they have been constructed of the same material present different appearances. Cracking of the surface is one of the greatest as well as one of the earliest defects that may develop in bituminous pavements. This may be due to one cause or a combination of several causes. Frequent cases are noted in bituminous wearing surfaces which, although apparently satisfactory mixtures in all other respects, contract as the base contracts and crack open at exactly the same point as the foundation. Again, cases are noticed of otherwise satisfactory pavements which crack because of their failure to receive the amount of traffic necessary to give the pavement its full compression or to iron out and close up the surface after low temperatures have tended to open it up by stretching the bituminous binder.

Effects of Improper Design

A condition of the sort last described, however, may have been hastened considerably or even caused directly by what might be called improper design of the pavement in the first place.

The bituminous surface mixtures expected to receive heavy traffic should be tough and fairly hard in order to resist displacement. Those designed for light traffic should be softer and more yielding, and this is accomplished by using a softer bitumen—that is, one of a higher penetration. Failure to do so means that as the pieces of mineral aggregate contract or shrink in volume during cold weather, they exert a spreading force in the surrounding bitumen which it cannot withstand because of its lack of light fluxing oils and corresponding ductility or ability to stretch; in other words, pavements containing hard or non-ductile bituminous material will have a greater tendency to crack in cold weather. Similar results and even general disintegration of the wearing surface may have been produced by too little bitumen in the mixture, since this is largely a measure of the life and elasticity of the pavement, and, similarly, overheated mixtures suffer a hardening and reduction of bonding power of the bitumen with consequent tendency to crack and wear. Aside from faulty drainage, poorly proportioned mixtures and unsuitable ingredients contribute largely to the failures in this type of pavement.

Disintegration

A bituminous concrete pavement which is satisfactory in all other respects may show surface indications of slight disintegration. The material in all probability has been attacked by the elements and evidence of wear is shown as the gloss is gone and the discoloration of the surface, which approaches a light brownish hue, is noticeable. This is speedily followed by a general porous condition and, if not promptly attended to will allow the surface to retain moisture which will eventually break the bond of the material and result in raveling and failure of the pavement.

Wavy Surface

The wavy condition of the surface found in the bituminous macadam roads is also common to the bituminous concrete types. This condition is usually found on well-traveled streets, especially on grades, and is caused mostly by the bituminous mixture being too soft, which gives it a tendency to push under traffic. A wavy surface may be attributable to the methods used in the construction of the pavement for, if in the building the material was not at a temperature suitable for raking to a uniformly loose condition, or crept under the roller as a result of careless handling or being rolled while too hot, an irregular surface would result. Pushing or waving in local spots may often be traced to the laying of the mixture on a dusty or dirty surface.

Deterioration Along the Edges

The wearing and deterioration along the edges of bituminous pavements where there is no header, is responsible for one of the most troublesome and expensive forms of repairs to roads of this type. The traffic continually irons out the surface along the edges and this spreading or flattening out produces a feather edge along the sides. The moisture and foreign material tracked on from the shoulders soon attack the bituminous material and result in the crumbling or breaking away of the surface which occasions extensive repairs. This condition is more pronounced when the material in the shoulders is of a non-porous nature or is poorly drained.

Methods of Repairing Bituminous Concrete.

In the repairs to the bituminous concrete pavements, special care is required in determining the methods and materials to be used. Taking the several conditions enumerated in the foregoing in their order, we first have a cracked bituminous surface and, unless the cracks are caused by some serious form of disintegration in the pavement, they can be repaired by cleaning them out thoroughly and pouring them full of either a hot or cold bituminous material of the proper grade, and thereafter tamping or wedging stout chips into the crack, thoroughly sealing it. If the crack is wide enough and the edges have crumbled or broken off, they should be cut down evenly and the opening filled and tamped with a mixture of the bituminous cement and stone chips in a proportion of one part bituminous cement to nine parts chips, in sufficient quantity to insure complete closure.

New Surfacing

When the entire surface is cracked or broken and is uniformly bad and gradually crumbling away, due to the disintegration of the material from any of the several causes hereinbefore mentioned, it becomes necessary to remove the old material and replace with a new surface. If the condition exists only in local spots this will develop into pot holes or depressions, which can be repaired by cutting out the affected areas down to the foundation and replacing with a new mixture.

Character of Bituminous Material to Use

The character of the bituminous material to use depends entirely upon the conditions in each case. Unless the repair work is extensive, it is not deemed advisable to use hot bituminous compounds in this work, not only from an economic standpoint, but from a point of convenience as well. Small repairs in the proper season can be handled economically and efficiently with cold bituminous cement, and if the proper mixture is used in the regular working season excellent results can be obtained.

Patching with Other Materials

It is conceded that hot bituminous repairs are not gener-

ally satisfactory when made at low temperatures, but in some places the avoidance of this practice has been carried almost to a fault. As an example, in some of the larger municipalities where defects have developed in the surface during the winter months, the affected portions have been removed and repaired with brick or stone block. This method is not only objectionable on account of the annoyance to traffic but, when the regular season for repairs arrives, it is usually found that additional work is required, occasioned through the inequality of the surface. It has been stated by some of the advocates of this method that it is an assurance that the affected portions will not be overlooked when the repair work is taken up in the spring. It has been demonstrated, however, that where conditions are so acute that this method is warranted, there is justification for making special arrangements for preparing and placing a suitable bituminous mixture which will be more satisfactory in the interim and, whereas, probably not a complete success, will offer as good, if not better, opportunities to correct later than the first method, which seems only to be justified when repairing cuts made in the pavements by public service corporations in the winter season.

Light Surface Application

When the surface of a bituminous concrete pavement begins to show that the bituminous material is disintegrating and the surface has a dry, porous appearance, similar to the appearance of the bituminous macadam pavement previously described, the surface can be revived by a light bituminous surface application the same as in the former case.

Reconstruction of Wavy Pavements

The wavy, irregular surface on bituminous concrete pavements is one of the most unsatisfactory conditions pertaining to the bituminous type of pavement. It is a defect that in most cases is proof positive of the inability of the pavement to meet the traffic requirements, except when the fault may have resulted from the methods used in the construction rather than the materials. If the materials have been found unsatisfactory and the irregularity of the surface is increasing steadily, reconstruction will eventually be necessary.

If the surface is only affected in local spots due to any of the other causes enumerated, this area may be removed and replaced with a new mixture which has been properly selected and strict attention should be given to the requirements of the mixture in order that a repetition of the original deficiencies cannot obtain.

When the proper material has been used in the original construction and the surface is irregular through careless methods in spreading, beneficial results can be obtained from rolling the surface in hot weather with a tandem power roller operated by a competent man.

Repairing Edges

In the repairs to the edges of a bituminous pavement not confined by headers, the first and most essential thing to do is to correct the cause, if possible. If the drainage of the shoulders or base is faulty, this should be taken into consideration first and ample provision made therefor. On shoulders which are composed of non-porous material, it is advisable to cut scuppers or small surface ditches at intervals of approximately 20 ft. along the road and, in addition to this the material immediately along the edge of the pavement should be replaced for a depth of a few inches with broken stone or gravel tamped into place to produce a more stable buttress for the new bituminous material. The patches should be made by removing the affected area and replacing with new mixture. Successful repairs should neither be above nor below the surrounding surface when finally compacted.

Central and Portable Mixing Plants

In municipalities where there is enough yardage to warrant a central mixing plant, this is the most satisfactory method of handling bituminous repairs. With every facility at hand to compound the mixture properly, more uniformity is assured and much of the personal equation resulting from separate organizations is eliminated. There are localities where possibly small portable mixing plants would meet the requirements and give satisfactory results. However, under ordinary conditions, the problem is generally a small town with probably several short streets or some other unit, such as a county or state, with continuous stretches of miles of interurban bituminous pavements or highways. In either case, it means one or a number of outfits performing the repair work, which conditions give strength to the demand for simple and efficient methods. With trained men, good hot bituminous mixtures have been prepared by hand, but considering the chances taken in overheating the material the careless proportioning and mixing and the extra expense in connection with the handling of the equipment, etc., it does not justify this method.

Cold Bituminous Mixture

The cold bituminous mixture with the proper material is the most economical and fool-proof method for ordinary repairs. The material can be mixed on a regular mixing board, stock prepared for future use, if need be, and stored at convenient intervals along the road and, aside from the small tools, such as shovels, rakes and tampers, no other equipment is absolutely necessary. Repairs have been made with cold bituminous mixtures on extremely heavy traveled roads that are in excellent condition after four seasons of wear.

Acknowledgement

The foregoing discussion is, slightly condensed, the paper presented by Mr. Biles before Section "D" of the American Asosciation for the Advancement of Science on December 28, 1917.

How Various Cities Meet Repaving Costs

An inquiry recently made by the Commission of Publicity and Efficiency of the city of Toledo, concerning the practice in other cities, indicates a tendency in the East to place repaving costs on the municipality, while in the West the general practice is to assess most of the cost against the abutting property.

New York and Seattle

This fact is borne out by a statement from Prof. Robert M. Haig, of Columbia University, a recognized authority on the subject. In a letter to the commission, written in answer to a query, Prof. Haig declared: "There is the greatest diversity of practice in assessing the cost of repaving. Here in New York City the property owners can be assessed for only one first-class pavement. But this is a rule which has grown up because of abuses in the direction of extending installments over unreasonably long periods. Farther west, particularly in the far West, the opposite practice prevails. For example, Seattle has recently paid for the repaving of its main street by special assessments."

Thirty-One Minnesota Cities

A report made by the League of Minnesota Municipalities shows that of thirty-one towns and cities in that state, eighteen of them assess all improvements against benefited property, eight pay the entire cost out of the general fund and five divide the cost between the city and property owners.

Los Angeles and Buffalo

In Los Angeles the whole cost of any improvement may be charged to the property owner. There is no restriction on the assessment. The city council may fix the city's portion at its own discretion.

In Buffalo, on the other hand, the charter provides that

when a street is repaved or resurfaced, not more than two-thirds of the expense may be raised by local assessments. The remaining one-third must be paid out of the general fund.

Columbus and Akron, Ohio

Columbus has a unique plan of dividing the cost. The city's share of original improvements is the same as in Toledo, with a minimum of 2 per cent plus intersections. But the charter provides that "Whenever an assessment is levied for the replacement of any improvement for which an assessment has theretofore been made, there shall be deducted from the assessment that might otherwise be made for such replacement, at least one-half of the amount paid on the assessment for the original improvement." The amount deducted is then added to the city's share.

In actual practice, however, the city of Columbus pays half the expense of repaving jobs, plus intersection costs, just as is done in Toledo. The commission was so informed by the Columbus Bureau of Information and Publicity.

Word comes from the city engineer of Akron that, unable to meet the costs of repaving on the plan of 50 per cent by the city and the rest by property owners, the city has refused to have work done unless the owners agree to shoulder the entire cost. Where this plan has conflicted with the prohibition against assessing more than one-third the value of any property, the work has been left undone.

FROM WORKERS IN FIELD AND OFFICE

Water Waste of 9,000,000 Gals. per Day Eliminated in Buffalo, N. Y.

To the Editor:

It may be of interest to your readers to know that in the City of Buffalo we have eliminated water waste amounting to 9,000,000 gals. a day, due to underground leakage alone. These leaks were all discovered by means of the Pitometer Survey and there was no evidence of them apparent on the surface.

In our work up to date, we have covered less than one-half the city. The total reduction in consumption up to date, due to elimination of waste of all kinds, is 35,000,000 gals., based on an estimated figure for the probable average daily pumpage of 1918, had no steps been taken to eliminate waste. This figure was based on the average yearly increase over a period of ten years.

E. D. CASE,
Manager, The Pitometer Co.

New York City, Sept. 13, 1918.

Some Large Wood Stave Pipe Lines on Power Installations

To the Editor: The 46-in. continuous wood stave pipe which we installed for the Hydro Electric Power Commission of Ontario, at Eugenia, is 3,400 ft. long and operates under a head of 100 ft. The staves were made from British Columbia fir and are 2 ins. thick. The steel bands used are ⅝ in. diameter and connect with malleable cast iron shoes. This line was installed in 1914 and has since been in continual use, giving every satisfaction to the purchasers.

The foregoing size of pipe is by no means the largest we have constructed. In the Cobalt region of Northern Ontario we have built a 9-ft. and an 11-ft. pipe for the Northern Canada Power Company. Throughout British Columbia we have built many lines ranging in diameter from 3 to 4 ft., with heads running as high as 400 ft. We have one line 6 ft. in diameter which has a 310-ft. head at the junction of wood stave and steel pipe.

We are now engaged on another contract with the Hydro Electric Power Commission for a wood stave pipe 13 ft. 6 ins. diameter, 1¼ miles in length, at the plant of the Ontario Power Company, Niagara Falls.

In all cases the best quality British Columbia fir is used for the staves. Stave thickness varies according to the size and pressure of the pipe. The material is manufactured at our plant here and assembled by our forces on the ground.

PACIFIC COAST PIPE CO., LTD.,
Vancouver, B. C. By H. C. JAMES, Secy.-Treas.

Reports Indicate Increasing Use of Trenching Machinery by City Water Works Departments

Since the publication in MUNICIPAL AND COUNTY ENGINEERING for September of the article relating the success of the Board of Water Commissioners of Detroit, Mich., in offsetting man shortage and rising costs by using machinery for water main extension work, a number of reports have been received from other cities indicating a quite general adoption of labor-saving machinery wherever municipalities have had any considerable amount of trenching to do this season.

Mr. L. J. Clancy, assistant general superintendent of the Detroit Board of Water Commissioners, writes as follows: "Your article as a whole is very good and covers our situation thoroughly. The cost data on trenching machinery is not in such shape just yet that accurate figures are obtainable, but I would venture to say that the trenching machinery has cut our costs in half besides solving the labor problem. In 1915 it cost $2.45 per lineal foot for digging a trench for 48-in. pipe and this year, using a steam driven Austin machine, it cost about one-sixth of that amount. The Buckeye and Austin machines used on trenching for 12, 8, and 6-in. pipe rendered equally efficient service and cut costs one-half or more."

A trenching machine and backfiller have proved a good investment for Buffalo, N. Y. Writing of his experience with trenching machinery as water commissioner of the city of Buffalo, Mr. George C. Andrews says:

"In May, 1918, we purchased a No. 00 Austin Trencher and No. 2 Austin Backfiller for use on our extension work. The reason the department purchased these was the fact that in 1917 it was impossible to obtain labor to work on city ditches, and also, that war work demanded considerable work in the outlying districts of the city where it would be possible to operate trenching machines without hindrance. Shortly after purchase of these machines it was necessary for the department to lay 9,600 ft. of 36-in. main to supply essential war industries with water. While this Austin machine we own is only designed to dig 3 ft. 6 ins. wide, it was possible for us to dig a 4-ft. trench with it and the line was so laid out that the machine was used on 3,179 ft., which was dug in actual operating time of 93 hours. This is by no means the capacity of the machine. The average depth of this trench was over 7 ft. Besides the work on the 36-in. line, trenches were dug for 6,457 ft. of 6-in. pipe; 1,070 ft. of 10-in. pipe and 2,830 ft. of 16-in. pipe. The backfiller has also been a great labor saver."

Mr. Ray Crozier, engineer and superintendent of the Peoria

Water Works Co., Peoria, Ill., writes: "Our Parsons trenching machine was purchased in 1916 at the time when the shortage of labor was beginning to be felt, also when the wages of laborers began to advance. We consider our trenching machine very necessary at the present time on account of the extreme labor shortage."

At Minneapolis, Minn., water main extension work has been considerably curtailed during the past season. The water works department owns a large Austin trenching machine but such work as was done this season was for small pipe, requiring a smaller machine. Mr. J. A. Jensen, supervisor of water, writes that it has been impossible to maintain the crews at even 50 per cent. of the usual strength and in conclusion says: "We have a large Austin trench excavator used on heavy work two years ago, and we hope to have similar machinery for smaller mains in order to effect the economy that is possible by their use."

Mr. F. P. Lannon, acting general manager of the Metropolitan Water District of the city of Omaha, Neb., states that the Parsons trenching machine used by his department has made a decided saving in labor costs, but the exact figures are not yet available.

Mr. Owen T. Smith, secretary and superintendent of the Freeport Water Company, Freeport, Ill., reports that his company used a Buckeye trenching machine to such good purpose that the price of the machine was saved several times over in laying 17 miles of 4-in. to 16-in. mains which had to be completed within a short period of time to comply with franchise requirements.

The water pipe extension division of the Chicago Department of Public Works maintains one construction gang equipped entirely with machinery. This gang is supplied with three Austin trenching machines; one large machine for 48-in. main jobs and two small machines for digging trenches for 6 to 24-in. pipe. This gang is also supplied with two pneumatic air compressors for operating calking hammers, an Orton & Steinbrenner locomotive crane for handling large pipe, one large capacity gasoline-driven trench pump, and various smaller equipment.

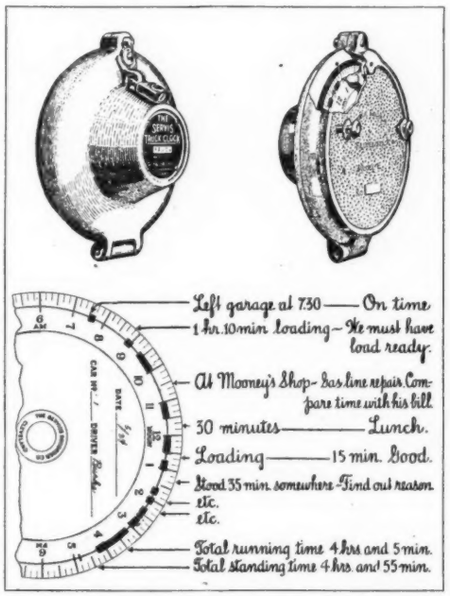
Supt. Ed. W. Humphreys, of the Erie (Pa.) Water Works, reports on the speed with which his department has been able to rush water main extensions to new industrial sections of Erie by utilizing a Pawling & Harnischfeger trenching machine. Work was carried on right through last winter and results were obtained that would have been impossible with hand labor, even if laborers could have been obtained.

PLANT UNITS AND LAY OUTS

Device for Recording the Movements of Motor Trucks

A mechanical device for recording the movements of motor trucks from minute to minute throughout the day is here illustrated. A sample record is also shown. This device has just been placed on the market by the Service Recorder Co., of Cleveland, Ohio.

Such items as these are shown in the record: when the truck reported for work, how long it took to load, how long to make various trips, when each delay occurred and the length of each delay, how long it was held up at the freight station, or at the shipping dock, or in the yard, and many other interesting facts, including when the truck turned in at night, and whether it was used during the night.


Left garage at 7.30 — On time
1 hr. 10 min. loading — He must have load ready.
At Mooney's Shop — Gas line repair. Compare time with his bill.
30 minutes — Lunch.
Loading — 15 min. Good.
Good 35 min. somewhere — Find out reason.
etc.
etc.
Total running time 4 hrs and 5 min.
Total standing time 4 hrs. and 55 min.

DEVICE FOR RECORDING MOTOR TRUCK TRAVEL WITH SAMPLE RECORD.

It records this information on a paper disc. This disc is laid on the desk of the dispatcher or other official of the operating company. And when he comes to glance over it he finds out that in nine cases out of ten, the driver is not to blame for expensive truck delays. Instead some department of the business is at fault. Then he revamps his shipping department, puts in quick loading devices, arranges his routes on a scientific time schedule and perhaps saves an hour a day.

The side-sway is pronounced in the motion of the motor truck, and is present no matter how smooth the road or how straight the line of travel. It is entirely distinct from vibration and should not be confused with it.

This side-sway, then, tells that the vehicle—whether motor truck, horse-drawn wagon, locomotive, or even motorcycle—is in travel motion, and the absence of it indicates that the vehicle is standing. This instrument not only records this side-sway, but records it when it happens.

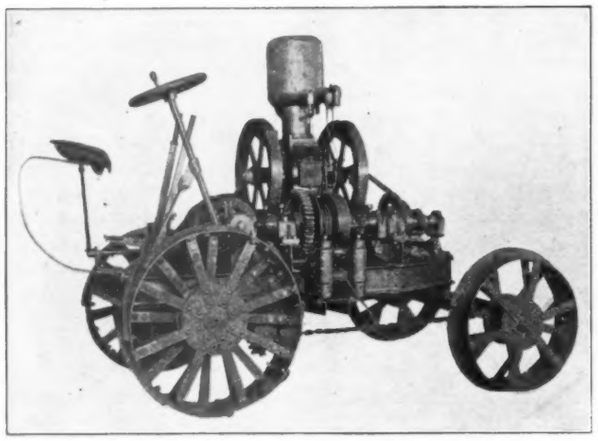
The device consists of but two elements: First, a pendulum mass which will swing from side to side in response to the side-sway of the moving vehicle, and second, a chart rotating at clock speed, upon which the pendulum marks a record which indicates that side-sway, and hence travel is going on. Of course, the absence of this record shows that the vehicle is standing. The pendulum records its oscillation on the chart by means of a stylus that is set in the pendulum near its point of suspension.

Trench Backfiller of Drag-Line Type

The trench backfiller here illustrated, of Pawling & Harnischfeger manufacture, is of the drag line excavator type and is designed to backfill all ditches ordinarily cut with trench excavators for water, gas or sewers. This backfiller has established a reputation for dependability and economical performance.

The car body is built up of two 6-in. channels running the length of the unit and cross-connected by means of 6-in. channels where necessary. The machinery base, consisting of two 6-in. channels, is mounted on top of these beams. The main machinery consists of one intermediate shaft, chain connected to the engine, and one drum shaft, gear connected to the intermediate shaft..

The drum runs loose upon the shaft and is connected to it by means of a cone clutch lined with asbestos lining. The drum is 7-in. in diameter for ⅜-in. steel rope. The intermediate shaft is connected to the engine by means of a high-speed roller chain of 1-in. pitch. A cone clutch is provided on the intermediate shaft, enabling all machinery to be placed out of action. A steel bevel pinion on the end of the intermediate shaft is provided with two semi-



POWER BACKFILLER FOR FILLING MACHINE-CUT TRENCHES.

steel bevel gears on the propelling shaft. These gears are provided with clutches, by means of which propelling motion is obtained in either direction. The propelling speed is approximately 1½ miles per hour.

The steering machinery is mounted under the car body and is operated by a worm and worm wheel, which is self-locking. Connection between this shaft and the front axle is by means of chains. The steering shaft is hand operated, a large hand wheel, with handle being provided for this purpose.

The operating levers are located at the rear of the machine and are so grouped that they can all be reached from one position.

A scraper 4 ft. wide, of Fresno type, is furnished with the machine.

The machine is driven by a 6-H.P., single cylinder vertical, hopper cooled engine running at 450 revolutions per minute, and connected to the machinery by means of a high-speed roller chain. The fuel tank is located in the base of the engine, pump being provided to deliver the fuel to the mixer. The engine is provided with an efficient governor for regulating its speed.

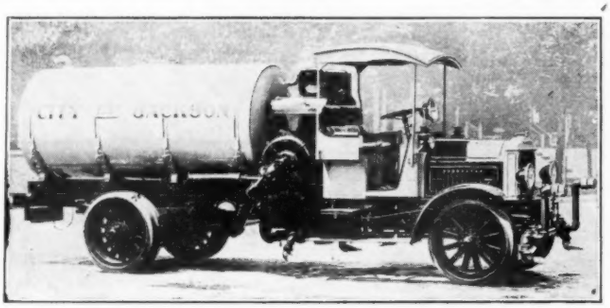
The major dimensions of the backfiller are: Out to out of rear wheels, 5 ft.; wheel base, 6 ft.; weight, in working order, about 4,000 lbs.

Combination Motor Flusher and Sprinkler for Jackson, Michigan

The city of Jackson, Mich., is now equipped with the type of motor truck flushing and sprinkling apparatus here illustrated. It is believed to be the first combination flusher and sprinkler. This is a 3½-ton Federal truck with flusher and sprinkler equipment.

Heretofore Jackson has operated two or three horse drawn sprinkling wagons capable of covering about two city blocks at one filling. The cleaning of pavements has been done entirely with sweepers. Now, with this new type of combination power flusher and sprinkler, the dirt will be literally blown off the street with the four flushing nozzles, which have a water pressure of 40 to 60 lbs., giving sufficient force to flush a 40-ft. street, while the two sprinkling nozzles can cover an 80-ft. street.

The water is carried in a 1,000-gal. tank with an independent power plant, a four cylinder motor mounted behind driver's seat ahead of the tank. This is the only unit of its kind built so far with a starter on the auxiliary engine. With this type of extra power plant the truck motor is not robbed of driving power and a steady pressure is at all times main-



FEDERAL 3½ TON TRUCK WITH FLUSHER AND SPRINKLER EQUIPMENT, AS OPERATED AT JACKSON, MICH., WHERE IT SUPERCEDES THREE SPRINKLING WAGONS AND SWEEPERS.

tained for flushing purposes. Pressure can be instantly regulated from the driver's seat to insure proper radius or spread of stream.

The pump driven by the auxiliary engine is a single stage centrifugal direct connected to the engine by a universal joint and has a 3-in. suction and a 2½-in. discharge nozzle.

The truck is equipped with generator and storage battery and four electric lights permit sufficient night street cleaning. Two big headlights, a tail light and a large search light furnish a splendid light for this purpose.

Applications of the Dravo Whirler

Shipyard requirements have acquainted builders with the tower whirler made by the Dravo Contracting Company, Pittsburgh, Pa. These whirlers can be erected quickly, and work fast and continuously in handling heavy material. The tower whirler consists of a standard Dravo whirler, mounted on a movable tower from 40 to 60 ft. high. The whirler carries a boom from 50 to 65 ft. long, and turns through a full circle in approximately a half minute. At its extreme working radius it will lift a 10-ton load.

The tower is mounted on four wheels and travels at the rate of about 200 ft. per minute along a 20-ft. gage track. Locomotives and cars can pass beneath the tower. Towers are usually constructed of timber, on account of the steel shortage and to facilitate ease of installation. The operator is 40 ft. or more above the ground, where he can watch the load constantly, without reliance on signals.

Tower whirlers are built either for electric or steam drive. When electrically operated, the usual voltage is 230 direct current, taken from three rails well protected by wood boxing. Hoisting and swinging motors are in the whirler cab, while the traveling motor is located on a platform about half way up the tower. When steam is the motive power, the hoisting, swinging and traveling drums are in the cab, as well as the boiler. Either coal or oil is used as fuel. Tower whirlers are being installed in public yards that do nothing but outfit ships built elsewhere. They are also being used in marine and rail-

VIEW OF THE DRAVO WHIRLER.

way terminal work for the rapid handling of material on and off ships. These whirlers are widely used by sand and gravel contractors on account of their speed and large area of operation, and by general contractors in a wide variety of work. They are used by railroads and large industrial plants for coal handling and storage yard material handling.

A Line of Single and Double Road Planes

The double road plane manufactured by Angus McCallum, Pontiac, Mich., is here illustrated. This plane is designed for the care and maintenance of gravel and dirt roads. It can be adjusted by the lever which deflects the rear blade and controls the depth of the cutting blade in the center. This eliminates waves and depressions in the road service and facilitates drainage. The plane is 10 ft. long, 5 ft. wide, weighs 400 lbs., and can be drawn by two horses, motor truck or tractor.

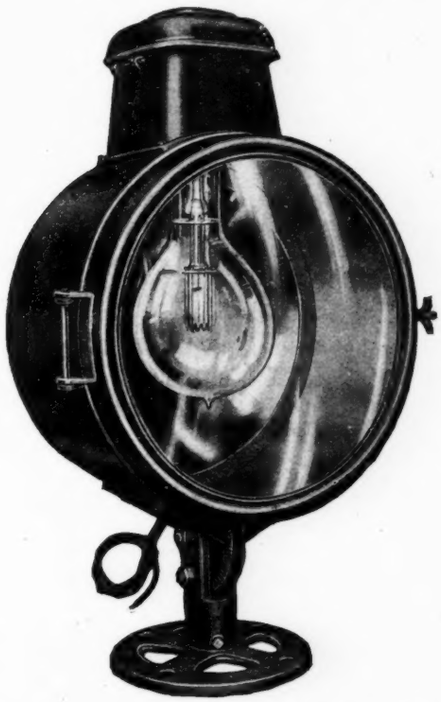
The double plane takes a width or road of from 9 to 12 ft., working road material toward the center and filling depressions. It is claimed that two men with truck or tractor will cover 20 miles and more per day in crowning earth or gravel

McCALLUM DOUBLE ROAD PLANE IN OPERATION, OAKLAND COUNTY, MICH.

roads with this plane. The single plane covers a width of 5 ft. at a time; a third plane is for use on roads from 12 to 20 ft. wide and consists of a double plane with cutting blades both angling the same way, which goes up one side of the road and back the other. The weight of the entire machine is on the cutting blade until the end blades strike and this accounts for the great cutting capacity on hard surfaces. The county road commissioners of Oakland county, Michigan—John A. Adams, Leonard, Mich., chairman, have 49 of these planes in use.

A New Flood Lighting Projector

A new flood lighting projector, designed for short range work where wide dispersion of beam, with relatively small concentration of light is desired, is here illustrated. This is the type FL-1419 Flood Lighting Projector, manufactured and marketed by the Electric Service Supplies Company of Philadelphia. These projectors are equipped with 14 in. long focus type parabolic reflectors, which are supported in steel, felt-lined shells, securely held throughout the entire periphery.



FLOOD LIGHTING PROJECTOR FOR SHORT RANGE WORK.

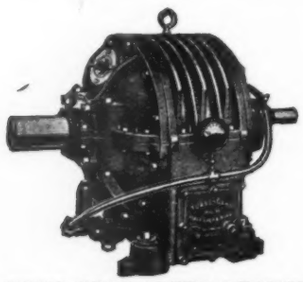
These projectors are adapted to use standard type 750 to 1,500 watt Mazda C (or nitrogen filled) lamps, and are equipped with standard Mogul sockets, arranged with a universal focusing device, by which the filament of the lamp may be brought to the focal center of the reflector and securely locked.

The projector illustrated has a maximum height of 29½ ins., maximum depth of 14¾ ins., and a maximum width of 18 ins., and weighs 54 lbs. Projectors of this type are very efficient in lighting night work in industrial and construction operations.

The Turbo-Gear and Its Application to Turbine-Driven Centrifugal Pumps

In connecting centrifugal pumps or other apparatus to the driving unit some form of speed transforming equipment is necessary. This is because the power unit requires a greater or less speed than the driven unit. There is, therefore, a demand for a speed increaser or decreaser which is efficient, occupies small floor space, is unaffected by dirt or moisture and that requires a minimum of attention and ad-

justment after installation. It is claimed for the reduction gear, here illustrated, that it meets all these requirements. It is called the Turbo-Gear and is manufactured by the Poole Engineering Company of Baltimore, Maryland.



TURBO-GEAR SPEED REDUCER.

The Turbo-Gear differs from other reduction gears in that there are no over-hung shafts or gears, all shafts and gear members being supported on each side—thus insuring permanent alignment. The Turbo-Gear operates without noise or vibration. It will drive in either direction of rotation without making any changes in it. It is light in weight. It can be furnished in any ratio from 4 to 1 up, and in any capacity from 1 to 20,000 H.P.

An example of the application of the Turbo-Gear to a pump drive is as follows: An 85 H.P. gear direct-connected to a General Electric turbine running at 3000 R. P. M., and driving a C. H. Wheeler centrifugal pump at 870 R. P. M.

New Expansion Coupling for Connecting Water Meters Into Straight Line Pipes

To meet the demand for an efficient expansion coupling, E. H. Ford, of the Ford Meter Box Company, Wabash, Ind., has designed a fitting which will be of interest to the water works fraternity and the plumbing trade.

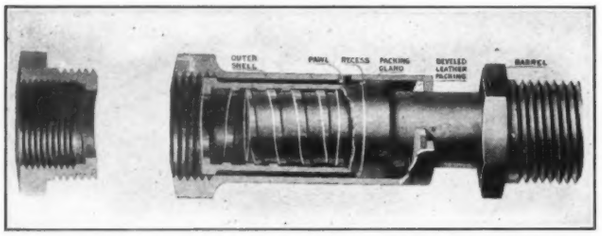


FIG. 1—CROSS-SECTION OF NEW FORD EXPANSION COUPLING.

This coupling, while designed primarily for the purpose of connecting water meters into straight line pipes, may be used in any place where flexibility is required in water, gas or steam piping. It is made now in three sizes, for ⅝, ¾ and 1-in. meters and may be used in connection with ½, ¾ and 1-in. pipe. No special tools are required for its installation.

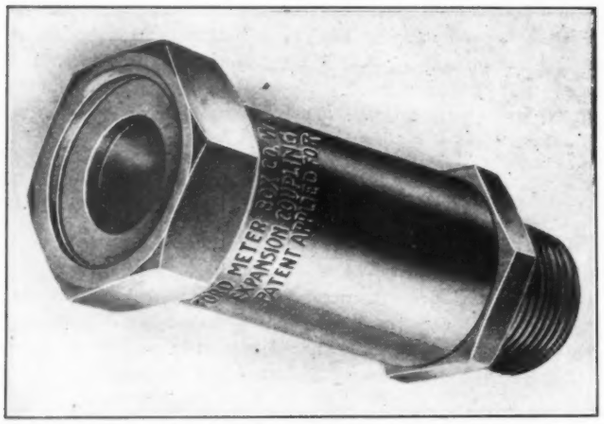


FIG. 2—FORD EXPANSION COUPLING CONTRACTED.

This coupling is shown clearly in cross section in Fig. 1, and its simplicity is apparent. It is composed of only three parts and the three sizes mentioned provide expansion range

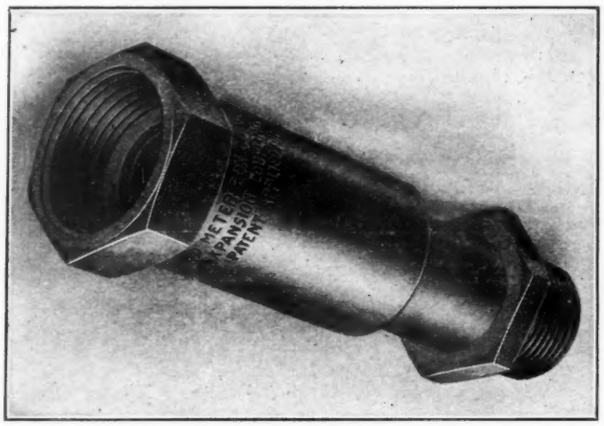


FIG. 3—FORD EXPANSION COUPLING EXPANDED.

of ⅝, ⅞ and 1-in. respectively. Sample couplings have been subjected to test pressure of 300 lbs. without showing leak. Figs. 2 and 3 show external views of coupling both expanded and contracted.

The Ford Meter Box Company is now placing these couplings in production and expects soon to have them on the market.

Equipment for Heating and Distributing Bituminous Road Material

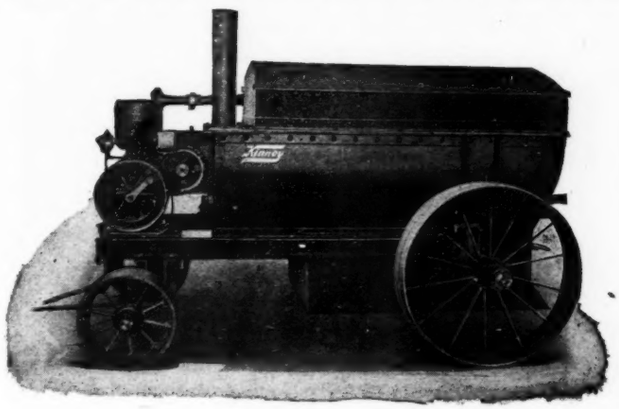
The equipment here illustrated and described is made by the Kinney Manufacturing Company, Boston, Mass., for heating and distributing bituminous road material for maintenance and repairs of roads and highways.

The heater and distributor are furnished in both automobile and horse-drawn types, using the Kinney rotating plunger pump for furnishing pressure. An improved system of heating and circulation insures heating efficiency, with no danger

THE KINNEY HEATER AND DISTRIBUTOR AS OPERATED IN PROVIDENCE, R. I.

from overheating. The distributor is also furnished in a special type of construction adapted for handling heavier materials when used in barrels instead of tank cars. In this machine the heat is derived from wood, coke or coal fires in a

similar manner to that in familiar makes of tar kettles. It may also be equipped with the Kinney heating and circulating system, the same as in the auto or horse-drawn distributors mentioned. This apparatus is of especial advantage in the work of maintenance or for more limited construction work. In the handling of all kinds of heavier grades of bituminous materials, requiring to be heated to a high temperature, especial care should be taken that no moisture be allowed to come in contact with the material in the process of heating. A slight amount of water will cause the material to froth or foam and become less valuable for road work. This possibility is always present when steam is used for heating. In all types of the Kinney apparatus no steam is used, the heat being derived direct from the Kinney kerosene oil burners in the automobile and horse-drawn types of apparatus and from wood or coal fires or kerosene heaters in the "Handy" heater and



THE KINNEY HANDY HEATER AND SPRAYER.

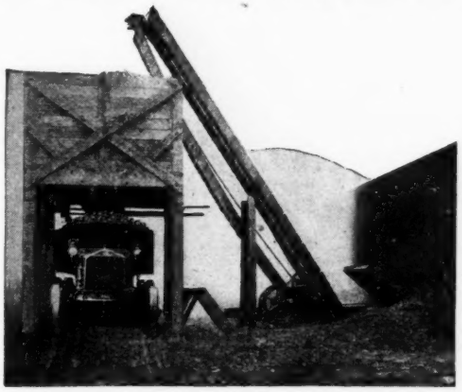
distributor. In the automobile and horse-drawn types of apparatus the heat from the kerosene oil burners is conveyed through tubes placed in the interior of the tank. This, together with the Kinney circulating system, eliminates, it is claimed, all possibility of danger from introduction of moisture, and also from burning or overheating.

In the heater and distributor the side control of the spray is so arranged as to swing the distributing pipes and nozzles 2 ft. on either side, so as to insure perfect contact of the successive applications without overlapping or leaving bare spots on the road. The circulating device is, in effect, an agitator, and produces a uniform temperature throughout the contents of the tank and hastens the process of heating. The control is so positive that the dripping of oil on cross-walks is easily prevented. An open connection is provided for the attachment of a hose and nozzle for hand spraying or patching under pressure.

The "Handy" heater and sprayer is furnished with power or hand-driven Kinney pump. It has a welded steel tank and is self-loading from heating kettles or tank cars. The pump and spraying hose are always hot and cannot become clogged. Suitable strainers prevent obstruction of pipes and spray nozzles.

A Continuous Operating Car Unloader

A strictly one-man machine of improved design is the Panama continuous operating car unloader, made by the F. B. Zieg Manufacturing Company, Fredericktown, Ohio. The unloader consists essentially of a steel box which is placed under the track. This has an eccentric driven movable bottom, which operates with a shaking motion, and delivers the material to the buckets which carry it up and into the bin. To install the box it is necessary to excavate a hole 2 ft. wide, 1 ft. deep and 8 ft. 6 ins. long. The unloader measures 6 ft. x 7 ft. It is claimed that this unloader will completely empty a gondola car of limestone in from 40 to 60 minutes, at a cost of approximately 1c per cubic yard, which is about one-tenth to one-fifteenth of the cost of unloading by hand. It will handle sand or limestone screenings as efficiently as crushed stone,



THE ZIEG CONTINUOUS OPERATING CAR UNLOADER.

whether the material is wet or dry. The conveyor frame is made in two parts and may be shortened, if desired, to make an outfit for loading directly into wagons. Wagons are driven directly under the bin, so that they load full and evenly. The outfit consists of the unloader complete with heavily constructed bin of one-half or one-car capacity, and a 6-h.p. gasoline engine of improved design.

PERSONAL ITEMS

C. A. JENNINGS, manager of the Chicago office of Wallace & Tiernan Co., has been commissioned captain in the Quartermaster Corps, Maintenance and Repair Branch, Construction Division, United States Army, with headquarters at Washington, D. C. Mr. Jennings was superintendent of the famous Bubbly Creek Filtration Plant at the Chicago stock yards from its inception in 1908 until two years ago. His work at Washington will be under Major George A. Johnson, and he will look after water supplies and sewerage systems at the various cantonments.

L. H. GOEBEL has resigned as Superintendent of Filtration and Chief Chemist of the Water Filtration Plant of the Union Stock Yard and Transit Company, Chicago, Ill., to become associated with the engineering staff of Wallace & Tiernan Company, manufacturers of chlorine control apparatus and sanitary engineering specialties. After graduation in Sanitary Engineering at Purdue University, Mr. Goebel was attached for a time to the Union Stock Yards filtration plant and subsequently was Sanitary Engineer, City Chemist, and Bacteriologist of Cedar Rapids, Iowa, returning to the Union Stock Yards Company early in the present year. Mr. Goebel will be attached to the Chicago office of Wallace & Tiernan Company.

AUGUSTUS HUNT has been appointed City Engineer of Crookston, Minn. Mr. Hunt was engaged in engineering work on the Valier-Montana Irrigation Project in 1911, on the Coon Rapids Dam at Anoka, Minn., in 1912 and for the past five years has been Assistant City Engineer of Minot, N. D.

W. A. FULLER and A. H. BEARD announce the formation of the firm of Fuller & Beard, Engineers, Chemical Building, St. Louis, Mo. W. A. Fuller, formerly of the Fuller-Coult Com-

pany, after having acquired Mr. Coult's interest in the company's engineering business last year, was called East to take charge of the designing of the water supply, fire protection, sewer system and sewage disposal, as sanitary engineer for the United States Shipping Board, Emergency Fleet Corporation, at Hog Island, Pa., the largest shipbuilding plant in the world, has completed the work for the government and has returned to St. Louis. A. H. Beard was with the American Water Works and Guarantee Company, of Pittsburgh, Pa., from 1905 to 1908, as constructing engineer on the construction of their water filtration plants at South Pittsburgh, Pa., Suffolk, Va., Chattanooga, Tenn., and St. Joseph, Mo., and for the past ten years has been superintendent of construction for the Pennsylvania Department of Health in charge of all construction at the State Sanitoria at Mont Alto, Cresson and Hamburg, Pa., including water works and sewage disposal.

F. L. STOCKBERGER, superintendent of the municipally owned garbage-and reduction plant at Cleveland, has resigned to enter another line of work. He is succeeded by Chas. C. Smith, until recently connected with the municipal lighting plant, and who was assistant superintendent of the garbage plant several years ago.

Norman P. Gerhard, for 10 years assistant engineer, Board of Water Supply of the city of New York, recently accepted a position as resident engineer on work at Cumberland, Md., for Jas. H. Fuertes, consulting engineer, New York City.

C. E. Tilton has been appointed city engineer of Phillipsburg, N. J.

R. H. Wiedman has been appointed city engineer and water commissioner at Whitefish, Mont.

Leroy C. Smith, who for several years was deputy state highway commissioner of Michigan under Frank Rogers, with headquarters at Lansing, has been appointed chief engineer of the Wayne County, Mich., Road Commission.

CATALOG REVIEWS

Truscon Building Products Booklet; issued by Truscon Steel Company, Youngstown, Ohio; 104 pages; 3½ x 6 ins. This is a new edition of this popular, useful and convenient little publication, issued for architects and builders. The small size is such that the booklet can be conveniently slipped into the pocket. The booklet contains a great fund of useful tables and information for architects and builders. It is a digest of the numerous elaborate catalogs published by this company. It contains complete information on the various Truscon products, tables of carrying capacities, strengths, etc. This is the eighth edition, and has been completely revised to bring it up to date. The products given special attention are: Reinforcing steel, Floretyles, Hy-Rib and metal lath, pressed steel joists and studs, highway reinforcements, curb bars, concrete inserts, steel windows, steel buildings, hollow tile, chemical products, etc.

Concrete Mixer—Issued by the F. C. Austin Company, Ind., Chicago, 84 pages; 8 x 11 ins. Relates to the Austin Cube Concrete Mixer. Illustrates and describes this type of mixer very completely in all its various mountings. The various component parts of the mixer are illustrated and described, and their special uses enumerated. Many illustrations are shown of mixers of this type as operated on important construction jobs throughout the country. Gives specifications for mixers of different sizes and types. Gives operating records. The Austin Paver is especially well illustrated and described, with specific information on the utility of concrete roads. Data also given on the construction and maintenance of concrete roads.

Road Building Machinery—Issued by Port Huron Engine and Thresher Co., Port Huron, Mich.; 24 pages; 8 x 11 ins. Illustrates and describes the line of road building machinery manufactured by this company, including rollers, dump wagons, scarifiers, dump cars, road sprinklers and engine tenders.

Rex Record—Issued by the Chain Belt Company, Milwaukee, Wis.; 16 pages; 8½ x 11 ins. Volume 1, No. 1, issue of the Rex Record, the house organ of the Chain Belt Company, dated June, 1918.

Sewer Cleaning Equipment—Issued by the Turbine Sewer Machine Company, Milwaukee, Wis.; 48 pages; 7 x 10 ins. Illustrates and describes the sewer cleaning equipment manufactured by this company, with special reference to the Turbine Sewer machine, the Turbine windlass, the Turbine forcing jack, iron and wood sewer rods and telescoping sewer braces. Gives many testimonial letters showing the value of the Turbine sewer machine, and shows many illustrations of accumulations of foreign materials removed from pipe sewers by means of this machine. Operation of the cleaning equipment fully illustrated and described.

Mixer Loader—Issued by the Koehring Machine Company, Milwaukee, Wis.; 4 pages; 8½ x 11 ins. Fully illustrates and describes the essential features of the construction and operation of the Koehring concrete mixer loader. Gives specifications for the loader also.

Squeegees and Sand Spreaders—Issued by The Kindling Machinery Co., Milwaukee, Wis.; 44 pages; 6 x 9 ins. Gives report of New York tests on street washing machines, and report of the operations of the street cleaning division at the Engineering Department, District of Columbia, Washington. Fully illustrates and describes the company's new motor-driven squeegee for cleaning large areas of smooth pavement. Also illustrates and describes the sand spreader.

Sand Tester—Issued by Kolesch & Company, 138 Fulton St., New York; 12 pages; 4 x 9 ins. Fully illustrates and describes the construction and operation of the Universal Sand Tester, by which anyone can make accurate sand analysis.

Tarvia-A—Issued by the Barrett Co., of New York; 3½ x 6 ins; 16 pages. Pertains to the use of Tarvia-A as a road preservative and dust preventive. Illustrates several roads of this class. Describes the methods of construction employed on these roads in detail. Gives bibliography on other booklets relating to Tarvia. Also by the Barrett Co., a pamphlet entitled, "The Avenue of Sublime Peace;" 6x9 ins., 16 pages. Illustrates and describes the first modern highway in China's Forbidden City. This is a Tarvia road; also illustrates Tarvia roads in the Hawaiian and Philippine Islands.

Trade Notes

The Pittsburgh Testing Laboratory has turned over its building and equipment at Seventh and Bedford avenues, Pittsburgh, Pa., to the United States government for the duration of the war. From April 1 until about June 15 its offices will be in the B. F. Jones Law Building, Fourth avenue and Ross street. After June 15 the offices and laboratories will be located at 612 to 620 Grant street, the building being remodelled and fully equipped for its special needs.

The plant of the Warner Manufacturing Co., Beloit, Wis., has been busy for the last three months executing a government contract for heavy-duty Warner trailers. Shipment overseas is now being made. These trailers are intended for use in the motor ammunition trains in France. They are a standard type Warner, four-wheel model. The regular Warner specifications are used throughout, except that the army has ordered U. S. standard pintle-eye in place of the famous Warner ball and socket hitch.

Tarvia

Preserves Roads—Prevents Dust

This photograph shows an auto-tank sprayer applying "Tarvia-B."

West Michigan Pike near Whitehall, Mich., before it was treated with "Tarvia-B."

The same road made smooth, dustless, and traffic-proof with "Tarvia-B."

How Good Roads Pay!

A few years ago the West Michigan Pike (illustrated above) was an arid stretch of sandy road in dry weather with here and there a boggy spot which became a quagmire in wet weather.

Over this pike the farm-wagons labored slowly carrying *extra-light* loads to market. A good-sized load couldn't be hauled.

Today the Whitehall Section of the pike has a smooth, firm, easy-traction Tarvia surface that is free from dust and mud.

Over it moves more traffic in a week than formerly passed over it in a month. From miles out along the pike comes customers who rarely were seen in town before the Tarvia road shortened the trip.

The ineffectual grading and filling and draining and wholesale ouerhauling which the old road required so often is now all done away with.

The Tarvia road is automobile-proof, frost-proof, and water-proof.

As a community investment, the new road pays huge dividends—dividends in maintenance savings, in increased property values and in greatly increased business—for the farmers can now haul their produce to their markets quickly and easily.

Today the nation needs good roads as never before. The public highways offer the only means of helping out the railroads and adding to our transportation facilities. The improvement of our highways is essential to win the war quickly.

Illustrated booklets free upon request.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston
St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis
Nashville Salt Lake City Seattle Peoria
Atlanta Duluth Milwaukee Bangor
Washington Johnstown Lebanon Youngstown Toledo
Columbus Richmond Latrobe Bethlehem Elizabeth Buffalo Baltimore

THE BARRETT COMPANY, Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

CONTRACTS AWARDED

ROADS AND STREETS

Ala., Camp Sheridan—Simmons, Hartenstein & Whitton, Charlotte, award. contr. by War Dept. to construct hwy. at Camp Sheridan, near Montgomery, at $200,000.

Ark., Little Rock — Stewart-McGehee Constr. Co., Little Rock, award. contr. by War Dept. to construct 14 miles of road, in addition to erecting 200 barracks for officers' training school, mess hall, drill hall, etc., etc., total est. cost $6,000,000 to $7,000,000.

Cal., Fillmore—Fairchild-Gilmore-Wilton Co. award. contr. for paving certain streets in Fillmore, at $22,818.

Cal., Los Angeles—Fred Hoffman award. contr. for disintegrated pavement on Sierra Madre road, Antelope Valley, at $50,000. Special stipulation made that contract would be cancelled if Capital Issues Comm. refuses to permit bond issue.

Cal., Madera — H. Crummey, Hearst Bldg., San Francisco, award. contr. for paving Sixth St., betw. "B" and "H" Sts., at $37,599.

Cal., Manhattan Beach—R. S. Quarrier, 711 S. Los Angeles St., Los Angeles, award. contr. for paving abt. 13 blocks on Ocean Ave., in Manhattan Beach, at $18,960.

Cal., Oakland—Bates & Boreland award. contr. for road betw. Decoto and Irvington, at $103,580.

Cal., Sacramento—F. C. McIntire, Farmers & Merchants Bldg., Stockton, award. contr. for grading 11 miles betw. San Ardo and San Lucas, Monterey Co., at $117,268.

Cal., Sacramento—A. Rolandi, 550 Montgomery St., San Francisco, award. contr. by State Hwy. Comn., for grading 15.9 miles road betw. Tower House & Redding, Shasta Co., at abt. $185,864.

Cal., Santa Ana—Sharp & Fellows, Los Angeles, award. contr. for abt. 1 mile of road around Sulphur Slide, Santa Ana Canyon, at $30,001.

Cal., Vallejo—Worswick Constr. Co. award. contr. for additional paving on Pennsylvania, York and El Dorado Sts., at $34,646.

Ct., New Haven—Franklin Contg. Co., 52 Vanderbilt St., New York City, award. contr. for paving various streets, at about $20,000.

Del., Wilmington—Eastern Paving Co., Philadelphia, award. contr. to construct portion of Lincoln Hwy., betw. Pike's Crk. and Marshalltown, at $206,661; Braisdell Engrg. Co., Brooklyn, award. contr. to construct a mile of Faulkn Rd. near Blue Ball, at $46,003. Award. subject to approval of Alfred I. DuPont, who is to bear one-half the expense of construction.

Fla., Dade City—J. W. Kergin award. contr. for asph. and clay-surfacing at $40,000.

Fla., Lake Worth—E. W. Bunker and G. F. Bullard, Lake Worth, award. contract to repair and rebuild streets at $80,000.

Ida., Boise—W. Hastings, Spokane, award. contr. by Heyburn Park Comn., for road construction in Heyburn Park on shores of Lake Coeur d'Alene, at $20,000.

Ida., Coeur d'Alene—Carscallen Bros., City, award. contr. for constr. of 12 mile road in Fourth of July canyon, at $150,000.

Ida., Grangeville—J. B. McCully, Nezperce, award. contr. for grading and surfacing with macad. 4.25 mi. of road at approx. $48,000.

Ill., Decatur—S. A. Suttle award. contr. for creo. wood blk. paving on 4 streets, at $80,568.

Ill., Joliet—R. F. Conway Co., 133 W. Washington St., Chicago, award. contr. for improving Whitney Ave., at $46,475.

Ill., Rochelle—Hart & Page, Rockford, award. contr. for paving with conc. 4½ miles of the Meridian Hwy. in Winnebago Co., at $66,066.

Ill., Staunton—H. M. Johnson, Mt. Olive, and J. Wood, Mt. Olive, award. contracts for 29 miles conc. walks, at $84,221.

Ind., Delphi—Lyon & Minix, Flora, Ind., award. contr. for constructing gravel rd., at $27,995; Smith Bros., Flora, award. contr. for constr. gravel rd. in Carrollton Twp., at $10,540.

Ind., East Chicago—Shea & Co., Hammond, award. contr. for paving 139th St., conc., at $16,500.

Ind., Indianapolis—American Constr. Co. award. contr. for improving 38th St.—Emerson Ave. to Pendleton Pike—with conc. rdway 50 ft. wide, at $61,000.

Ind., Indianapolis—Adam Swank, Nashville, Ind., award. contr. by Commrs. Brown Co., for Wilson road, Jackson Twp., at $12,000.

Ind., Nashville — Adam Swank, City, award. contr. for constructing road in Jackson Twp., at $12,000.

Ind., Richmond—Sheehan Constr. Co., City, award. contr. for construct. rdway to Speedway City, at approx. $173,500.

Ia., Knoxville—P. Shugart & Barnes, Nevada, award. contr. for grading Knoxville-Red Rock, Knoxville-Tracy, Knoxville-Columbia and Knoxville-Pleasantville Rds., involving 12 miles finished grade, at $.359 and $.37 per cu. yd.

Kans., Hoisington—Stamey-Mackey Constr. Co., Hutchinson, award. contr. for paving on 5 blocks, at about $20,000.

Ky., Louisville—Blokel Asphalt Paving Co., and Louisville Asphalt Co., both of Louisville, award. contracts for asph. and granite blk. paving at $57,963.

Ky., Walton—Claude E. Harris award. contr. for constructing concrete street through town, at $45,034.

La., Opelousas — R. M. Hollier, local, award. contr. for bldg. 8 miles of Kretz Spring road, 24 ft. wide (dirt), at abt. $24,000.

Mass., Arlington—M. De Matteo, 146 Dudley Ave., Roslindale, Mass., award. contr. for hwy. in Arlington, at $32,637.

Mass., Boston—B. E. Grant, 27 School St., award. contd. for paving 990 sq. yds. Commercial & Causeway Sts.—Hanover to Washington St.—granite blk. on conc. base, at about $75,570.

Mass., Boston—D'Onfro Bros., Leominster, award. contr. by Bd. Public Wks., for paving 10,000 sq. yds. Atlantic Ave.—S. Market to Commercial St.—granite blocks, at $74,411.

Mass., Boston—Bermudez Co., award. contr. for laying sheet asph. pavement in Saratoga St., E. Boston—Chelsea St. to Bennington St.—at $113,688.

Mass., Boston—Jas. H. Fannon award. contr. for grading and loaming; also walks, on Boston Common, at $5,392; Warren Bros., contr. for Topeka pavements—Washington St.——Talbot Ave. to Ashmont St., Dorchester—at $15,778.

Mass., Boston—Rossetti & Co. award. contr. for laying granite blk. pavement in Atlantic Ave.—Broad street to So. Market street, at $73,078.

Mass., Cambridge—Rowe Contracting Co. award. contr. for paving and placing Harvard brdg., at $135,400.

Mass., Chatham—W. Jones, Barnstable, award. contr. for bldg. highway, at $13,685.

Mich., Detroit—Otis Cement Constr. Co. award. contr. for excavating concrete paving, etc., on alleys, at $47,895; R. Porath and T. E. Currie, contracts for similar work, at $12,194 and $12,284, respectively. Contract covered 13 alleys; Detroit Asph. Paving Co. award. contr. for grading, curbing, asph. conc. paving on conc. fdn., etc., on Strong Ave., at $15,183.

Mich., Fenton—Meredith-Powelson Co., 145 Harper Ave., Detroit, award. contract for paving various streets, at $26,048.

Mich., Muskegon—Johnson Constr. Co. award. contr. for resurfacing sts. surrounding Hackley park and 3rd & Peck Sts., at $43,491.

Minn., Chaska—Hawkinson & Hohle, 3304 Longfellow Ave., Minneapolis, contract for surfacing 26 miles Jobs Nos. 1, 2, 3, 4, 5 Fed. Aid Project No. 12, at $30,261.

Minn., Pipestone—Campbell Constr. Co., 6050 Hennepin Ave., Minneapolis, award. contr. for paving 9 blks. of street, at $25,742; J. W. Hunt & Son, Pipestone, award. contr. for curbing at $3,054.

Minn., St. Paul—Fielding & Shelley, 216 University Ave., City, award. contr. for paving Pine St., at $37,438.

Minn., Slayton—R. G. Wright, Minneapolis, award. contr. for bldg. 29.1 mile State Rd. No. 5, involving 46,556 cu. yds. gravel surfacing, at abt. $62,000.

Minn., Willmar—Chas. Weaver, Anoka, award. contr. for excav. of Div. A, Project 31, State Rd. No. 6, at $29,423.

Mo., Jefferson City—Pope Constr. Co., City, award. contr. for grading, surfacing with gravel and macad., and constructing culverts and brdgs.; together with other incidental work on State Road—Huber's Ferry on Osage River to county line west of Centertown—at $127,402.

Mo., Kansas City—J. E. Welch award. contr. for repaving Eighth street—279 ft. east of Santa Fe street to Madison Ave.; also for repaving Mulberry street—9th to 13th St.—at $7.74 sq. yd.; Foxhall P. Mc-

You Can't do Good Work with Poor Sand

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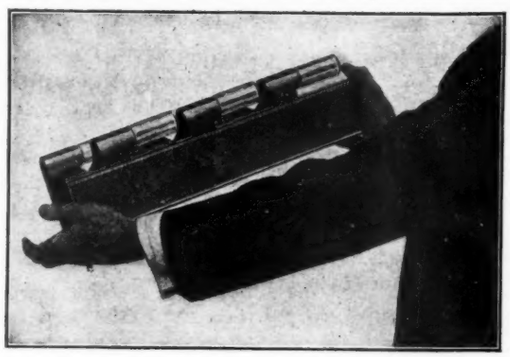

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TRADE MARK

KOLESCH & COMPANY, 138 Fulton Street, New York

Sole Manufacturers

Cormick, award. contr. for repaving Hickory St.—St. Louis Ave. to W. Kans addn.; also 13th St.—Liberty to Mulberry St., at $.73 sq. yd. Total cost of work estimated at $170,896.

Mo., Kansas City—J. C. Lyle, Kans. City, Mo., award. contr. for widening and resurfacing Parallel road in Wyandotte Co., from Linwood, Kansas, 2¼ miles east, at $29,990.

N. J., Camden—Rutherford & McNutty, award. contr. for improvement of Blockwood Rd.; also Browning Rd., at $32,000 and $10,000 respectively.

N. J., Jersey City—R. L. Emmer, 150 Nesbit St., Weehawken, award. contr. for paving Lincoln hwy., at abt. $15,300.

N. J., Jersey City—Lettieri & Sons Co., 261½ Wayne St., award. contr. for repairing 9th St.—from point east of Erie to Grove St.—wood blk. pavement at abt. $24,000.

N. J., Midland Park—W. Sybesma & Sons, Midland Park, award. contr. by City for grading, paving, guttering, at abt. $13,198.

N. J., Newark—Northern Constr. Co., City, award. contr. for placing new curbing in Bloomfield 9ve., running through Bloomfield, Contclair, Verona and Caldwell, at $27,500.

N. J., Newark—General Contracting Co., City, award. contr. for paving Richards St., at $19,335; Newark Paving Co., City, contr. for paving Passaic Ave., at $90,277.

N. J., Trenton — State Hwy. Comn. award, following contracts: Bldg. Sect. 1, Matua-Woodbury, Gloucester Co., involving 12,666 sq. yds. bitum. conc. to W. P. MacDonald Constr. Co., Mt. Vernon, N. Y., at $104,041; Route 15, Sect. 2—Kingston to New Brunswick, Middiesex and Somerset Cos., involving 47,800 sq. yds. conc., to Utility Constr. Co., 46 Patterson St., New Brunswick, at $335,199.

N. J., Trenton—Thompson & Glickman, Freehold, low bidder (??? lower than revised estimate of State Hwy. Engr.) for constr. of Burlington-Roebling section of state hwy. sys., at $273,235.

N. M., Tucumcari—Dan LaRoe, Palestine, Tex., award. contr. for constr. of 21 miles federal aid rd., from this city west, at $10,143.

N. Y., New York—Following contracts awarded by State Hwy. Comn., 55 Lancaster St., Albany: Dutchess county, 6.81 mi. Rd. No. 1312, to S. B. VaWegwenen, Inc., Rondout, at $104,735; Greene Co., 3.98 mi. Rd., 1346, to J. Walker, Albany, at abt. $62,347; Montgomery Co., part 1, Rd. 512, N. (timber crib) to C. H. Wilde, Jr., Port Johnson, at $9,764; Delaware Co., repair contr. 959, to H. W. Roberts Co., 610 Lansing St., Utica, at $3,269; Onondaga Co., Repair Contr. 1085, to Warren Bros. Co., 142 Berkeley St., Boston, at $49,431; Cattaraugus Co., Repair Contr. 1170, to Chenango Construction Co., Perth Amboy, N. J., at $29,977.

N. Y., Newburgh—Schunnemunk Constr. Co., Highland Mills, award. contr. for construction of 7 miles asph., macad. rd., at Long Lake West in Adirondacks, at approx. $200,000.

N. Y., Utica—Harry W. Roberts & Co., City, award. contr. for following street paving: Whitesboro—Lafayette to Vulcan St., $3,212; Lafayette St.—Genesee to Broadway, $9,592; Post St.—Burnet to Charlotte, at $5,181; Raylor Ave.—Arthur St. to W. Shore Ry., $10,119; State St.—Cooper to Spring St., $3,742; Court St.—State to Lincoln Ave., $2,965.

N. C., Camp Bragg—Boyd & Porter, Charlotte, award. contr. by War Dept., Washington, D. C., for construction of military hwy. to this camp.

O., Cleveland—Roehl Bros. and Enterprise Paving Co. award. contrs. for granite repaving on Detroit Ave., Lakewood, at $97,145 and $117,592, respectively; Baldwin Bros., contr. for wood blk., at $168,716.

O., Columbus—Ohio Permanent Constr. Co. award. contrs. for James Pike and 5th Ave. improvements, at $20,020 and $39,952, respectively.

O., Columbus—B. F. Patterson award. contr. for paving Jason Ave., in Clintonville, at $25,491. Street will be paved for abt. four blocks with "Nelson" brick.

O., Lakewood—Roehl Bros., W. 25th St. & Clark Ave., award. contr. for repaving Detroit Ave.—W. 117th St. to Rocky River, granite and wood block, 1st sect. (granite), at $97,145; Enterprise Paving Co., 8444 Bway, 2nd sect. (granite); also 3rd sect. (wood blk.), to Baldwin Bros., at $117,952 and $168,746, respectively.

O., Struthers—Wm. Kusecker, Youngstown, award. contr. for paving Lowellville road—Yellow Crk. brdg. to Center St.—at $22,875.

O., Sylvania—F. F. Marsh, R. D., award. contr. for paving and curbing Summit and Erie Sts., at $23,448.

Okla., Ardmore—D. C. Sampley, Berwyn, award. contr. to construct four miles gravel road and steel truss bridge, at abt. $30,000.

Ore., Galesville—John Hampshire Co. award. contr. for grading 14 miles Pacific Hwy., bet. here and Canyonsville, at $200,000.

Ore., Astoria—John R. Hill, award. contr. for constructing 5 mi. new rd. up Floras Crk. in northern end of Curry Co., at $12,455.

Ore., Portland—American Exploration Co. award. contr. for improvement of Pacific Hwy., by grading, for U. S. Forest Service (Canyonville-Galesville section), at $157,000.

Ore., Portland—S. S. Schell award contr. for macadamizing 1½ miles Pacific Hwy.—Divide to Comstock—at $14,537.

Ore., St. Helena—G. L. Tarbell & Son, Yankton, Ore., award. contr. for clearing and grading Koppler Rd., District No. 3, at $2,585.

Pa., Harrisburg — Following contracts awarded for road work in several counties: Stucker Bros. Constr. Co., Harrisburg, 17,795 ft. rein. conc., Pounsbury & Kennett Twps., Chester Co., at $87,177; also for 19,223 ft. rd. in Aston and Concord Twps., Delaware Co., rein. conc., at $132,186; Bunce & Carli, Olean, N. Y., for 6,260 ft. plain conc., in Smethport and Heating Boros, McKean Co., at $44,746; Booth & Flinn, Ltd., Pittsburgh, for 5,091 ft. plain conc., Ligonier Boro, Westmoreland Co., at $99,385.

Pa., Plains—Moses Griffith, local, award. contr. for laying 6,000 sq. yds. paving and curbing, at $18,000.

Pa, Pittsburgh—R. Swann, Jr., Co., Jenkins Arcade, City, award. contr. for grading and paving 8,560 ft. Noblestown Rd., Chartiers Twp., at about $175,911.

S. D., Watertown—C. N. Atkinson Paving Co., City, award. contr. for grading, draining and surfacing with gravel, approx. 13.27 mi. of Watertown-Minneapolis Rd., at $46,283.

Tex., Austin—G. L. Kennedy, San Marcos, award. contr. to construct hwy. improvements for county, at $8,200.

Tex., Cisco—Municipal Paving Co., Dallas, award. contr. for constructing 15,000 sq. yds. 3-in. brk. on 4-in. conc. base, and 1-in. sand cushion, at $32,700.

Tex., Del Rio—Uvalde Rock Asph. Co., San Antonio, contr. to construct rd. work on State hwy., to cost $37,000.

Tex., Wheeler—Sanders Bros., Miami, Tex., award. contr. by Wheeler Co., for bldg. 28 miles sand clay road, including excav., and conc. pavement, at about $68,000.

Va., Fredericksburg—Mr. Clay, Rd. Contractor, award. contr. for bldg. section of state hwy.—West Point, King William Co., to Saluda, Middlesex Co., at $44,000.

Wash., Olympia—G. L. Stickler, Colton, award. contract for constr. of 8 miles Sunset Hwy., Lincoln Co., at $65,696.

Wash., Pt. Townsend—P. M. Coyne, Pt. Townsend, award. contr. for clearing, grading and graveling 1.25 miles perm. hwy. No. 4-A, at abt. $10,000.

Wash., Seattle — United Paving Co., Northwestern Bank Bldg., Portland, Ore., award. contr. for hard-surfacing 6 blocks Clay and 10th Sts., 4½ blks. Webster St.—Kelly to Washington St., and 1 block Washington St., at about $23,323.

Wash., Spokane—Mitchell Bros., Paulsen Bldg., Spokane, award. contr. for grading and paving 950 lin. ft. Trent Ave.—W. Trent brdg. to Grant St., at about $15,578.

W. Va., Moundsville—H. L. Seabright, Wheeling, award. contr. for paving 1.03 miles Narrows Rd., at abt. $50,000.

Wis., Black River Falls—J. R. McDonald, local, award. contr. for Federal Aid Project 24—2.18 miles conc. surfacing—at $45,105.

Wis., Kewaunee — McMullen & Pitz, award. contr. by Manitowoc Co. Board of Supvrs., for approx. 3 miles of conc, rdway. —township line of Two Rivers to Manitowoc at $31,000.

Wis., Madison—J. R. McDonald, Black River Falls, award. contr. for bldg. 13,300 ft. Black River Falls-Melrose Rd., at abt. $47,000.

Wis., Milwaukee—Badger Constr. Co., Ry. Ex. Bldg., award. contr. for paving 27th St. —Cedar to Vilet St.—at $16,650.

Wis., Sparta—Nelson-Weber Co., Oconomowoc, award. contr. for constructing Federal Aid road, at $50,000.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Hollister—H. Gould, Sacramento, award. contr. for constr. of Hazel street sewer, at $3,915.

Cal., Kingsbury—Frederickson & Sharmon, 2823 Washington St., Fresno, award. contr. for constructing sewage disposal plant, at $27,102.

Cal., Martinez—M. P. Holesm, Berkeley, award. contr. for constructing sewer sys., at $34,549.

Cal., Martinez—M. P. Holmes, Berkeley, award. contr. for bldg. sewerage system, including treatment plant and pumping station for Martinez, and treatment tank for Fairview, at about $65,576.

Cal., Newport Beach—J. D. Keen Contracting Co., Santa Monica, award. contract for constr. of sewer system, at $172,371.

Cal., Pasadena—L. C. Trent Company award. contr. for constr. of experimental sewage treat. plant on Pasadena sewer farm so. of San Gabriel, at abt. $7,000. Pasadena, Alham and So. Pasadena interested.

Cal., Sacramento—Clark & Henery Constr. Co. award. contr. to construct sewer in Curtis Oaks and Highland Park districts at about $23,000.

Can., Windsor, Ont.—Merlo, Merlo & Ray Contracting Co., Windsor, award. contr. for constr. of eastern section of intercepting sewer that will serve Windsor, Walkerville and Sandwich, at $109,642. Work will be done on cost plus basis.

Colo., Brighton—J. S. Swartz award. contr. for constr. of new sewer system, at $67,000.

Conn., Hamden—Sperry Eng. Co. 82 Church St., New Haven, award. contr. for laying abt. 5,000 ft. sewers on Treadwell Ave., at abt. $21,000.

Conn., Hartford—O'Neil Bros., & A. C. Sternberg, Inc., Park and Mountain Roads, W. Hartford, award. contr. for bldg. 4,800 ft. 48-in. rein. conc. sewer conduit in W. Hartford and Farmington Boros, at abt. $135,830.

Ga., Camp Gordon—Southern Ferro-Concrete Co., Atlanta (general contractors), sublet contract to J. B. McCrary Co., Atlanta, to construct extension to sewer system at Camp Gordon, at $75,000.

D. C., Washington—Continental Constr. Co., Baltimore, Md., award. contr. for sewer at St. Elizabeth's Hosp., at $26,480.

Fla., Miami—J. J. Quinn Co., Miami, award. contr. to construct sewer in Highland Park at $27,660.

Kans., Leavenworth—O'Neil Constr. Co., local. award. contr. for constr. of sewers in Sewer Dist. 11, at $26,795.

Kans., Wichita—City will construct storm sewer No. 16 by day labor. Est. cost of work $34,899. P. L. Brockway, City Engr.

Ky., Ashland—Chas. W. Menhouse award. contr. for sewer construction on 26th St. and Cliffside, at approx. $2,702 and $2,500, respectively.

Ky., Louisville—M. L. Underhill, New Albany, award. contr. for const. of sewers in newly created sewer distr., in Silver Grove, at $2,372.

Mass., Boston—A. Cefalo, Boston, award. contr. for bldg. vit. pipe sewer in Washington St.—Market to Tip Top St.—at abt. $28,646.

Mich., Dearborn—Colman & Harding & Staffani, 702 Kresge Bldg., Detroit, award. contr. to build sewerage system, at abt. $185,000.

Minn., Duluth—Norquist & Berg, City, award. contr. for constructing a san. sewer in Hawthorne road, at $1,449; Leonard Hedberg, City, award. contr. for constructing san. sewer in 69th Ave., W., and Grand Ave.—Raleigh St. to 71st Ave.—at $4,402.

Minn., Ironton—Pastoret Constr. Co., 511 Lyceum Bldg., Duluth, award. contr. for sewer Dist. No. 1, at $5,200.

Minn., Duluth — Leonard Hedberg, Duluth, award. contr. for san. sewer in 69th Ave., W.; also Grand Ave., O Raleigh St. to 71st Ave. W., at $4,002.

Minn., Virginia—Larson Bros., Centad, O. and Emil Larson, 830 11th St., N., award. contr. for constr. of san. sewer system, at $5,849.

Minn., Virginia—Christopherson Co., Duluth, award contr. for bldg. sewers in 3rd St., S. & 3rd Ave., W., at $13,470.

Mo., Joplin—V. E. Koch, award contrs. for laying sanitary sewers in Dist. 28, So. Joplin, at $3,129.

Mo., Kansas City—Kinler Constr. Co., Kansas City, award. contr. to construct main sewer and laterals for district bounded by 59th, 63rd and Cherry Sts., and Troost Ave., at $51,390; Empire Constr. Co., City, contr. for constr. of joint sewer Div. 5, at $6,973.

Neb., Omaha—Following sewer contracts awarded by City Council: Minne Lusa ave., Mary street to north line of Minne Lusa addition—to J. J. Hanighen, at $109,306; 26th and H. Sts., to Mud Crk., at J St. to Katz Constr. Co., at $21,936; 13th & Locust Sts., to 15th and Laird Sts., to E. P. Donahue, at $34,603; Mud Crk. sewer, O Frederick St. to Lane Cut-off, to J. J. Hanighen, at $41,208; 13th St., Ohern to Jefferson Sts., to A. F. Hanson, at $6,377; Fourth St.,

William to Poppleton Ave., to H. J. Peterson, at $1,675.

N. J., North Bergen — Nolan & Horung Constr. Co., 143 Summit Ave., W. Hoboken, award. contr. for sewer in 30th St., at $7,458.

N. Y., Binghamton—Geo. Serafina, award. contr. by Bd. Contr. & Supply, for constr. of 7 sewers on various streets, at $6,245.

N. Y., Kings Pk.—New York Sewage Disposal Co., 37 E. 28th St., New York City, award contr. by State Hospital Comm., Capitol, Albany, for bldg., extension to sewage disposal plant at Kings Park State Hosp., at about $13,037.

N. Y., Long Isl. City—Jos. Rotti & Co., Maspeth, N. Y., aawrd. contr. for sewers and appurts. in Liberty Ave., Huntington St., and Rockaway Blvd., at $219,634.

N. Y., Tonowanda—Queen City. Plmg. & Htg. Co., 2672 Main St., Buffalo, N. Y., award contr. for installing sewers in Williams St., at $17,387.

N. Y., White Plains—E. L. Erbeck. award. contr. for No. White Plains sewer, sec. No. 2, at $28,282.

O., Cleveland—F. A. Fredericks, Triskett road. award. contr. for sewers in Clarkstone road and Ella Ave., at $3,433; M. Nichols, contracts for sewers in same section, at $1,519.

O., Cleveland—D. Zullo, 2265 E. 105th St., award. contr. for bldg. vit. pipe sewers in E. 30th St., Euclid to Chester Aves., at $48,908; Gould & Mayback, 823 E. 150th St., award. contr. for sewers in Euclid Ave., Ivanhoe Rd. to New York Centr. R. R., at $12,746.

O., Lakewood—G. Sam, Cleveland, award. contr. for bldg. vit. tile sewer in Belle Ave., Detroit Ave. to Clifton Blvd., at about $30,000.

O., Lancaster—Wm. J. Strachan, award. contr. for constr. of So. High St. sewer, at $3,089; also sewer No. 5, at $3,475.

O., Toledo—Peters Bros. Co., award. contr. to build joint city and county sewer from City Blvd., to Potomac Drive and other nearby streets, at $20,402.

O., Lockland—J. B. McLane & Co., Newport, Ky., award. contr. for laying 2,245 lin. ft. 12. 18. 30 and 36-in. sewer pipes in N. Cooper, Westview and Pershing Aves.; also Bacon St., at $13,135.

Ore., Wallowa—J. H. Childs, LaGrande, Ore., award. contr. for constr. sewer system for this city, including sewer and septic tank, at $15,125.

Pa., N. Braddock—Phillips & George, 1007 Spring St., N. Braddock, award. contr. for installing sewers in various streets at $1,994.

Pa., Turtle Crk.—Mancela Constr. Co., 1507 Lang Ave., Pittsburgh, award. contr. for constr. of sewer in Penn. Ave., at $3,200.

Pa., Williamsport—E. C. Williams, 150 E. 4th St., City, award. contr. for sewage disp. plant, at $15,000.

S. D., Mobridge—Schruth & Jackson, Fargo, award. contr. for sewer sys., at $48,725.

Tex., Carlsbad—Dalton & Campbell, Dallas. award. contr. by State Tuberculosis Sanitarium directors, J. B. McKnight, supt., to build sewage-disposal plant and extend sewers, at $23,000.

Tex., Dallas—Klein Bros. Co., Dallas, award. contr. to construct storm sewers on Lemon Ave. and Leonard St., at $20,000.

Tex., Electra—Winslett & Eldridge Co., 1001 Main St., Dallas, award. contr. for bldg. sewerage sys., and disposal plant, at about $52,388.

Tex., San Angelo—Dalton & Campbell, Dallas, award. contr. for immediate installation of sewage disposal plant at state tuberculosis sanitarium, at $23,000.

Wn., Grandview—C. H. Green, 517 N. Lincoln St., Spokane, award. contr. for installing sewerage system, at about $35,000.

Wn., Spokane—Jas. C. Broad, award. contr. for constructing sewer in 19th St., at $7,695.

Wis., Antigo — August Gamon, Antigo, award. contr. for constr. of storm sewer, at $50,000.

Wis., Plymouth—W. E. Ribbens, Mayville, award. contr. for constr. storm sewer, at $3,932.

WATER SUPPLY AND PURIFICATION.

Cal., Martinez — Michael Murphy, 1321 Melvia St., Berkeley, award. contr. for constructing distributing system for Martinez municipal water wks., at $78,205, deducting about $7,000; R. O'Halley, San Francisco, award. contr. for constr. of rein. conc. reservoir. His bid was for $28,800; a deduction of $1,800 was made for price of reservoir. He also bid $2,560 for constr. of pump house, and was award. the contract.

Cal., San Diego—Henry Clarke Co., 1101 E. 5th St., Los Angeles, award. contract for constr. water supply system at naval coaling station at La Playa, at $13,543.

Cal., Monrovia—S. T. Patey, 404 Thorpe Bldg., Los Angeles, award. contr. for digging 26-in. well 110 ft.; 16-in. well 300 ft., including casing, in San Gabriel Basin, at $6,550.

Cal., San Diego—Thos. Haverty Co., award. contr. for furnishing all labor and material for installing freshwater system at naval air school at North Island, San Diego.

Ia., Ayrshire—Des Moines Brdg. & Iron Co., Des Moines, award. contr. for standpipe for water works system at $6,125; Peter N. Kruse, Spencer, Ia., contr. for water mains, at $4,080.

Minn., Duluth — Simon Johnson, 818 E. Third St., City, award contr. for laying gas and water mains in Norton's Fairmount Park Addn., at $3,516.

Minn., Duluth — D. H. Clough & Co., award. contr. for water and gas mains in 85th Ave.; W. from Grand Ave., to Industrial St., at $1,320.

Minn., Eveleth—Lawrence McCann, Eveleth, award. contr. for installing water conduit bet. St. Mary's and Ely lakes, at $19,770.

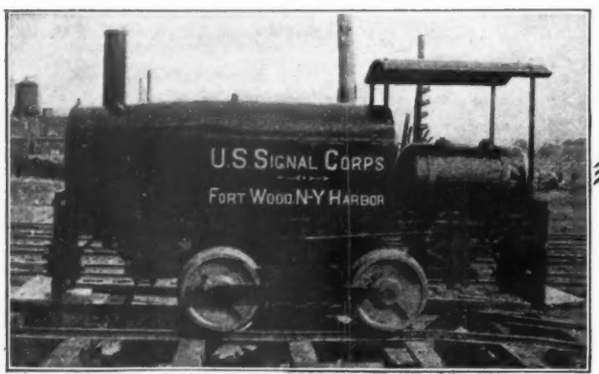
N. M., Clovis—C. Fisher & Co., Phoenix, Ariz., award. contr. for laying 18,000 ft. 4-in., 4,000 ft. 6-in., and 200 ft. Class C water pipes, at about $6,476.

N. C., Raleigh—Tucker & Laxton, Realty Bldg., Charlotte, award. contr. for water works improvements, involving installation of 2 pumps, addnl. filter system, 24-in. pipe line, etc., at abt. $50,000.

N. D., Grafton — J. M. Carroll, Grand Forks, N. D., award. contr. for laying 6-in. water main, Dist. No. 2, and 4-in. main in Dist. No. 3, at $9,326.

O., Akron—Alger & Krause Co., Guardian Bldg., Cleveland, award. contr. for constr. pumping station extension 31x67, machinery foundations and pipe laying, at $32,570.

Okla., Okla City—N. S. Sherman, Sherman Machine & Iron Wks., Okla. City, award contr. by city and govt. to raise dam at Lake Lawtonka, 15 ft. and increase water storg. capy. 5 times its present capy. of 5,000,000,000 gals; require placing 5,000 cu. yds. masonry on dam; lake supplies city, Fort Sill and Camp Doniphan with water.



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30 Church Street. **(Founded 1908)** **NEW YORK CITY.**

Tex., Fort Worth—W. T. Waggoner, First National Bk. Bldg., award. contr. for bldg. pump house, at about $52,387.

Tex., Waco—City will install settling basin at filtration plant by day labor. About $26,811.

Wn., Colfax—E. K. Lloyd, award. contr. for bldg. monolithic conc. pumping station, at $2,895.

Wn., Kirkland — A. S. Churchill, local, award. contr. for bldg. water sys., at about $12,000.

Wis., Cashton — Des Moines Bridge & Iron Co., 930 Tuttle St., Des Moines, award. contr. for bldg. and erecting 80,000-gal. steel tank and tower to replace 2 wooden tanks and towers, at $11,985.

BRIDGES AND BUILDINGS.

Cal., Alameda — Healy-Tibbitts Co., award. contr. for repairing Webster St. bridge, at $44,709.

Cal., Chico—Thos. N. Polk, award. contr. for two county bridges in this dist., one to span Mud Crk., on state hwy., at $2,473; the other over Angel Slough on Dayton-Litch, rd., at $9,943.

Cal., Merced—E. K. Angel, award. contr. for constr. of new brdg. on state hwy. at $2,400 by Bd. of Supvrs.

Cal., Oakland—Healy-Tibbitts Constr. Co. San Francisco, award. contr. for repairing Webster St. bridge across estuary, bet. Oakland & Alameda, at $44,709.

Cal., Oceanside—San Diego county will build by day labor 600 ft. rein. conc. trestle, 23 30-ft. spans, 21 ft. rdway, over San Luis Rey river, involving 1,235 cu. yds. rein. conc., 131 ton steel and 5,320 lin. ft. conc. pillars; Pacific Bldg. Co., 334 C St., award. contr. by Commrs., San Diego Co., for bldg. 960 ft. rein. conc. pile trestle brdg. over San Dieguito river, at about $72,950.

Cal., Red Bluff—Bordwell & Zimmerman, Napa, award. contr. for constr. of two rein. conc. arch bridges, each 400 ft. long, Tehama Co., at $38,000.

Cal., San Jose—A. Scarrino, award. contr. for constr. 5 conc. brdgs., Santa Clara Co., at approx. $13,343.

Cal., Ventura—E. M. Leadbetter, award. contr. for constr. of Coyote Crk. bridge in Foster Park, at $17,940.

Cal., Visalia—Edgar Noble, award. contr. for constr. of 5 conc. brdgs. on county hwy., unit from Lemon Cove to Merryman, at $7,090.

Colo., Byers—Levi Constr. Co., award. contr. for steel brdg., 120 ft. long, over Biyou Crk., near here, at $9,420.

Del., Wilmington—Luten Bridge Co., W. Market St., York, Pa., award. contr. by State Hwy. Comn., for bldg. 2 conc. arch brdgs. on Sec. 4, Lincoln Hwy., at $10,238; repairing Barkers brdg. to Elwood Talley at $12 per cu. yd. masonry, and $1.70 per cu. yd. for embankment.

Kans., Topeka—Allen & Fulton, award. contr. for constr. of bridge over the Chunganunge at Fourth St. at $23,794. Bridge will be of rein. conc., 100-ft. span arch, 20-ft. rdway, finished with asph. and two 5-ft. walks.

Ill., Carthage—M. A. Munson, city, award. contr. for constr. the Cheney brdg., Pilot Grove Twp., Hancock Co., at $3,700.

Ill., Chicago—Henry Ericsson, Chicago, award. contr. by U. S. Govt. for constr. of bldgs. at $7,410,000. Contr. will introduce new type of bldgs., work will be rushed and much labor required.

Ill., Clinton—M. E. Adams, Heyworth, Ill., award. contr. for bldg. conc. brdg., at $2,120.

Ill., Fox Lake—J. Keg, Blue Island, award contrs. for 1 steel and conc. bridge; 2 conc. culverts and 1 conc. bridge, at $25,000.

Ill., Patoka—T. E. Irvin, city, award. contr. for constr. following bridges: Allison & Wheeler brdgs., Patoka Twp., Marion Co., at $1,925; steel school brdg., Carrigan Twp., at $1,282.

Ill., Peoria—Ed Thorne, Mossville, award. contr. of rein. conc. bridge in Medina Twp., at $2,145.

Ill., Salem—Contracts for 14 bridges in Marion Co., awarded to: W. C. Johnson, Belleville, F. M. Sherman, Dix, B. F. Clark & Son, St. Louis, Mo., T. E. Irvin, Patoka, R. E. Gregory, Alona and A. J. Sligar, Centralia, at about $23,000.

Ill., Springfield — Following contracts awarded by Dept. Public Wks. & Bldg. for bridge construction: V. O. Connor, Newton, Ill., Bergbower, Connor, and Ellston and Fithian brdgs., Jasper Co., at $3,750; Wm. Hoos, Hoss brdg., Pike Co., at $1,160; Berenz & Son, Bloomington, White Oak, No. 1 brdg., McLean Co., at $7,050.

Mass., Boston—W. Roxbury Trap Rock Co., award contr. for rebldg. Belgrade Ave. brdg., W. Roxbury, at $43,500.

Mass., Williamsburg — W. J. Marshall, Rackliffe Bldg., Willingett, Holyoke, award. contr. for bldg. conc. and steel bridge, at about $15,000.

Mich., Ypsilanti—G. F. Bristol, 119 Winona St., Detroit, award. contr. by Mich. Central Ry., for bldg. rein. conc. viaduct, at about $40,000.

Minn., Anoka—Wm. O'Shea & Sons, 526 Ridgewood Ave., Minneapolis, award. contr. for 2 spans over Miss. bridge, at $3,189.

Minn., Clear Lake—M. A. Adams Co., 927 Andrus Bldg., Minneapolis, award. contr. for constructing steel and conc. bridge across St. Francis river at Santiago, at $6,700.

Minn., Madison—M. A. Adams & Co., 927 Andrus Bldg., Minneapolis, award. contr. for constr. of bridge 2925 over Lac qui Parle, Hamilton Twp., at $10,800.

Minn., Roseau—Minneapolis Bridge Co., award. contr. for constructing conc. brdg. over Roseau river, at $7,345.

Mo., Mexico — Lynch-McDonald Constr. Co., Moberly, Mo., award. contr. for constructing 2 rein. conc. bridges, each of 2,250-ft. spans with conc. pier and abuts., at $7,950.

Neb., Lincoln—A. A. Dobson Co., Lincoln, award. contr. for constr. of 2 bridges, at $4,000; Pioneer Constr. Co., Kans. City, Mo., contr. for bridge constr., at $16,000.

Neb., Lincoln—Following contracts award. for conc. bridges by Commrs. Lancaster County: Arthur A. Dobson Co., at $5,590 (5 brdgs.); Pioneer Constr. Co., $7,935 (3); Martin Constr. Co., $4,435 (2).

N. J., Bellemeade—A. L. Carhart, Hale Bldg., Philadelphia, Pa., award. tract for 140-ft. steel and conc. bridge, at about $50,000.

N. J., Flemington — F. W. Lee, Woodbridge, award. contr. to construct conc. bridge over Swan Creek, Lambertville, at $5,485.

N. J., Lambertville — F. R. Lee, Woodbridge, N. J., award. contr. for constructing conc. arch bridge over Swan Creek at Main St., 49-ft. span, at $5,480.

N. J., New Brunswick—Strauss Trunnion Bascule Bridge Co., award. contr. by Dept. of Interior, at $26,480.

N. Y., Mineola — Booth & West, Law-

Why Advertise Now?

Let W. B. Colver, Chairman of the Federal Trade Commission, answer this question.

"Discontinuance, or even sharp curtailment, of advertising because of temporary war conditions, would seem to imperil the most valuable asset that any business has, namely, its good will. No more faulty logic can be found than that which would impel a manufacturer to cease building for the future by means of advertising, simply because the output of his factory is for the time being restricted, or because diversion of his facilities to war work has operated to withhold his goods from accustomed markets. In modern business there can be no sufficient unto-the-day policy.

"In advertising the business man has built up the intangible or spiritual side of his business, if such it may be designated, as distinct from the material side. It is the spiritual side, as represented by the good will, that is slower of growth and that is the more seriously jeopardized by neglect—neglect which could take no more disastrous form than an interruption to advertising.

"Good will, in my estimation, is far more valuable than the physical property with which it is linked. * * *

"The manufacturer who has converted his factory to war work, and has therefore interrupted the production of his original line, does not tear down and discard his expensive machinery to save the insurance premiums or other similar expenses. It would be just as sensible for a manufacturer whose commercial integrity is founded upon advertising to abandon his advertising campaign in order to save the carrying charge upon his greatest asset, good will. * * *

"They told me when I was a youngster that 'even the Lord can't make a two-year-old calf in a minute.' Big advertising spreads after the war will meet equally big spreads. Business will bid for public attention and interest on a bull market. The purpose will be to put a punch in good will which has gone flabby. The man who goes into that contest with a public attention and interest which he has never allowed to relax will go in with his good will trained to the minute.

"He will win."

rence, award. contr. for constr. of brdg. near Hempstead, Nassau Co., at $7,998.

N. D., Linton—Linton Bridge Constr. Co., Linton, award. contr. for two culverts, at $8,368; D. D. Bidwell, Hazelton, award. contr. for two brdgs. and three culverts at $8,365.

R. I., E. Greenwich—O. F. Austin, Box 24, Providence, award. contr. for bldg. Big River brdg., rein. conc. 56 ft. long, 40 ft. span with 30 ft. rdway, at about $12,970.

Pa., Allentown—Butz & Clader, award. contr. to rebuild and repair Stone county bridge over Saucon creek at Center Valley, at $9,875.

Pa., Brookhaven (Chester P. O.)—Whitaker & Diehl, Union Tr. Bldg., Harrisburg, award. contr. by Commrs. Delaware Co., Media, for bldg. 56-ft. rein. conc. bridge, 28 ft. wide, at about $19,800.

Pa., Chester—Whitaker & Diehl, Union Trust Bldg., Harrisburg, award. contr. for remodeling bridge at 25th St. and Irving Mills, at about $15,684.

Pa., Kittanning—Ferris Engrg. Co., Empire bldg., Pittsburgh, award. contr. by Armstrong Co., to repair bridge over Kiskiminetas river, at about $13,200.

Pa., Phila.—Phila. & Reading R. R., Reading Terminal, award. contr. to L. H. Focht & Son, 529 Court St., Reading, for repairing bridge over Schuylkill river at Keystone, at about $20,000.

Pa., Washington—Allis Minton, Harveys, award. contr. for repairing brdg. over Captiers Crk., $25,000.

Pa., Wilkes Barre—Geo. W. Rockwell, Nanticoke, award. contr. for repairing west abutment to Market street bridge, at about $6,500.

S. D., Parker—Federal Bridge Co., Des Moines, and W. A. Adams & Co., 927 Andrus Bldg., award. contrs. for bridge work, at $16,000.

Tex., Austin—Geo. L. Kennedy, San Marco, Tex., award. contr. to constr. bridge, at $8,300.

Utah, Salt Lake City—Loaf Nelson, Logan, award. contr. for constr. of conc. brdg. over Logan river at Logan, at $11,510.

Wn., Seattle—Charles G. Huber, Central Bldg., Seattle, award. contr. by Lewis Co. Commrs. for new conc. pier and strengthening and raising steel bridge across Tildon river near Morton, at $7,897.

Wn., Seattle—Pearson Constr. Co., N. Y. Bldg., award. contr. for steel and wood bridge, by N. P. Ry. Co., at $56,000.

Wn., Walla Walla—Geo. Harding award. contr. for constr. 2 conc. bridges across Garrison creek on S. Ninth St., at $2,900.

Va., W. Elkins—Duncan Constr. Co., Marlinton, award. contr. for constr. of 3 conc. bridges, arch and slab types, 15 and 12 ft. spans, respectively, and one culvert, at $4,595.

W. Va., Morgantown—Geo. F. Watson, Middlebourne, award. contr. for constr. 3 conc. arch bridges at $10,823, $5,625 and $2,800, respectively.

W. Va., Summerville—Conc. Steel Bridge Co., Clarksburg, W. Va., award. contr. for constructing rein. conc. arch brdg. over Beaver Crk. and slab bridge over Rock Camp Crk., at $6,777.

Wis., Cedarburg—John Vollmar, local, award. contr. for conc. bridge, at $4,950.

Wis., Grand Rapids—Whitewater Bridge Co., Whitewater, award. contr. for constr. of Hemlock Brdg., Hansen, Wood Co., at $8,748.

Wis., Hayton—J. Young, Oconto, award. contr. for 45 ft. rein. conc. arch bridge, 24 ft. wide, at $10,000.

Wis., Madison—Jno. F. Icke, city, award. contr. for constr. of bridge across Starkweather Crk. on Milwaukee St., at $4,990.

Wis., Milwaukee—E. W. Taddy, city, award. contr. for bldg. conc. bridge over Kinnickinnic river, at Cleveland Ave., at about $10,860.

Wis., Morgan—Messenger & Rasmussen, Oconto, award. contr. for three bridges, at $4,950.

Wis., Holcombe—Alfred Brown, Holcombe, award. contr. for Rheingan brdg., rein. conc., at $3,700.

PROSPECTIVE WORK

ROADS AND STREETS.

Ala., Evergreen—$36,000 available for constr. of sand-clay roads by Corcuh Co. Commrs. Date of opening bids not set. J. M. Garrett, Montgomery, Ala., Engr.

Ark., Camden—Ouachita Co. Commrs. have plans by State Hwy. Dept., Little Rock, for bldg. series of roads radiating around Camden, which will include Buena Vista, Chidester, Mustin Lake and Kent. System will be 18 miles long of gravel and graded earth construction. About $74,457.

Ark., Clarksville—Johnson County Road Impvt. District No. 2 will construct penetration asph. roads; $160,000 available. C. H. Boskin, official in charge. H. J. Parks, Pine Bluff, Ark., Engr.

Ark., Little Rock—Plans being completed by State Hwy. Dept. for two hwys. in Conway county. First is system from Plumerville no.—27.30 miles long and 22 ft. wide. Est. cost $73,745; second rd., Morrillton to St. Vincent and Jerusalem, 26.62 miles long. 22 ft. wide. Est. $6,745. In each case cost includes bldg. of culverts, brdgs. pipes, etc., etc.

Ark., Mountain Home—Baxter county contemplates bldg. 7½ miles rd., Searcy Co. line to Stone Co. line, via town of Bigflat, about $11,791. State will appropriate toward cost.

Ark., Ozark—Plans prepared for Franklin Co., by State Hwy. Comn. for 8 miles gravel road, 12 ft. wide—Franklin to Johnson Co. line, through Letus, Ozark and White Oak to Franklin Co. line. Est. about $108,838.

Ark., Sheridan—Grant Co. Rd. Impvt. Dist. No. 2 (W. R. Rhodes, Secy., Ennis, Ark.), will construct 14½ miles gravel road. Bids will probably be asked late in Sept., or early in October. Parkes Engrg. Co., Engr., Pine Bluff.

Ariz., Superior—Work will be started on state hwy. through canyon near Superior next month. Three or four miles of road will be blasted out of the rock. Leroy A. Ladd, Chrmn. of Comn. on State Institutions.

Cal., Merced—In November citizens will vote on issuance of $1,250,000 bonds for improving hwys. in Merced county.

Cal., Modesto—Oct. 22nd. citizens will vote on $80,000 bond issue, for purpose of improving city streets, which connect with state hwy. sys.

Cal., Placerville—Plans under way to link Amador, El Dorado and Amador counties by new hwy.

Cal., Riverside—Plans to be prepared by Co. Surveyor Fulmor for improvement of Box Springs Hwy., Gage Canal on E. 5th St. to Santa Fe Ry., at top of hill; 3 ft. will be added to each side of paved road; and also improve present road.

Cal., Sacramento—Bids to be taken as soon as Capital Issues Comm. approves expendt. for constr. of state hwy., top of Tecate divide to Imperial county line. Road will be built with federal aid.

Cal., San Diego—Ord. passed by council providing for improvt. of La Jolla Blvd., Center St. to Pacific Beach Jct., with 5-in. conc., no top dressing.

Colo., Denver—Secy. of Agriculture has approved the Buffalo-Tensleep & Wind River Hwy. projects, proposed by the forest service in Wyoming. The Buffalo-Tensleep Rd. will connect the eastern cities, like St. Paul and Minneapolis, and the Dakota country with Yellowstone Park; the Wind River hwy., will afford a route from Denver to Yellowstone Park 100 miles shorter. Robert E. Pratt, Dist. Engr. of Forest Service, in charge.

Ct., New London—National Housing Co., contemplates laying out new sts., in connection with housing project. Plans include asph. or macad. pavement, conc. curb, gutters and walks, rock excav., etc. Abt. $70,000. L. J. Tribus, Care Natl. Housing Co., Engr.

D. C., Washington—Bureau Yds. & Docks, plans expenditure of about $16,000 for road improvements near Anacostia.

D. C., Washington—Government considering constr. of 60 miles of Gallup-Mesa Verde National Hwy., within Navajo Indian Reservation. Approx. cost $54,000. Cato Sells, Comr. Indian Affrs.

Fla., Jacksonville—State Rd. Dept. considering constr. of road from this city to Baldwin, Fla. Approx. cost $40,000.

Fla., Pensacola—Government will pave streets, lay sidewalks, constr. sewers, etc., etc., in connection with development of townsite so. of Bayou Grande, to comprise 100 houses which will be used for civilian employes of navy yard. Arthur Pew, Engr., Pensacola.

Fla., Pensacola—Escambia county considering impvt. of road from here to Molino to connect with Molino brdg. About $20,000; state has appropriated $10,000 toward project.

Ga., Columbus—$360,000 will be expended on Dixie Overland Hwy., in 1918-1919. Following counties will receive federal aid: Macon, $60,000; Muscogee (on brdgs.) $30,000; Dooly (roads) $10,000; Bleckley (rds. & brdgs.) $15,000; Candler (roads) $8,500; Bullock (brdgs.) $20,000; Emanuel (rds.) $25,000. Federal aid added to the amounts counties will expend is as follows: Macon, $120,000; Muscogee, $60,000; Dooly, $32,500; Bleckley, $30,100; Candler, $18,600; Bullock, $43,300; Emanuel, $55,000.

Ida., Boise—It is planned to expend abt. $340,000 for north and south Idaho State Hwy. H. C. Allen, State Hwy. Engr., Wallace.

Ill., Waukegan—Plans have been drawn for brick paving on Chapel St. Est. cost, $9,434. M. J. Douthitt, Engr., City Hall.

Ind., Terre Haute—Bd. of Directors have decided to pave Fort Harrison Rd., betw. Seventh St., and Lafayette Ave.

Ia., Davenport—Co. Rd. Dept. preparing to surface with gravel over 3,000 ft. of Davenport-Gambril road near Wapsie river.

Ia., Davenport—Park Lane and South Ave., will be paved; other streets will be graded, placed in condition and oil used as dressing. Streets to be improved are adjacent to new additions for government housing. W. S. Shields, Engr. of U. S. Housing Commission.

Kans., Atchison—City Council and Co. Commrs. considering paving of Main St., 15th to Harmony Garden, including new brdg. just east of Harmony Garden. Est. cost, $18,500.

Kans., Great Bend—Barton county considering construction of 30 miles of brk. road. W. F. Armstrong, Engr.

Kans., Leavenworth—Secy. of Agriculture has approved federal aid project of bldg. Fort to Fort Hwy., here to Fort Riley, which will take in 22 mi. in Leavenworth county. Government will expend $66,000 in this county. Est. cost of road $22,000 per mile, or $440,000 in Leavenworth county.

Kans., Topeka—Plans being prepared for constr. of 21¼ miles hard-surface road in Douglas county, extending across so. half of county on old Santa Fe trail and passing through Baldwin City and famous battlefield of Black Jack.

Mich., Chesaning—This and other Twps. in southern part of Saginaw Co., are promised good rds. in near future. Co. Rd. Commrs. have ordered a number of trunk line hwys. constructed and improved among which will be the continuation of E St. stone rd., Saginaw through Albee and Maple Grove to south county line, making connections to Howell and other southern towns.

Mich., Detroit—City considering paving 2,500 ft. Euclid Ave., east to boundary of Detroit, Grand Haven & Mich. Ry., to St. Aubin Ave., 46 ft. wide; also 900 ft. St. Aubin Ave., Euclid to Holbrook Aves., 46 ft. wide, rein. conc. or asph. C. B. Hubbell, City Engr.

Mich., Monroe—City Surveyor instructed to make preliminary survey or proposed pavement on N. Main St., end of present paved district to city limits; also to submit cost estimates of conc. brk. and gravel pavements for the extension.

Mont., Helena—Paul Pratt, Ch. Engr., State Hwy. Comn. is initiating state road project in Lincoln county. If labor is available, a constr. crew will be placed on the 57-mile hwy. across main range of Rockies, Belton to Glacier Park Station, to complete the project by fall.

Minn., Bemidji—Beltrami Bd. Co. Comrs. have decided to construct state road betw. Cass Lake and western border of county. Est. cost $130,000.

Minn., Minneapolis—Hennepin & Dakota Cos. will build hwy. from Cedar Ave. bridge so. to Northfield, 27 miles. C. M. Babcock, State Hwy. Comr.

Minn., St. Paul—Comrs. Ramsey Co., contemplate grading and surfacing 12 roads—approx. 14 miles long—with clay, gravel and asph. macad. Cost $100,000. G. J. Reis. Co. Aud.

Miss., Greenwood—Le Flore Co. Supvrs. will issue $98,000 bonds for rd. improvements. Eli Abbot, Hwy. Engr. A. R. Bew, Chancery Court Clk.

Miss., Woodville—Wilkinson county voted $60,000 bonds for constr. of Prentiss Hwy. through county.

Mo., Benton—Scott County Commrs. plan to build 27½ miles of gravel hwy. to cost $200,000. M. S. Murray, Engr., Sikeston, Mo.

Mo., Bethany—Harrison County Commrs. plan to expend $140,000 for road construction. M. G. Brown, Engr., Centerville, Ia.

Mo., Carrollton—Carroll Co. plans election soon to vote on $700,000 for bldg. roads.

Mo., Charleston—Mississippi County Commrs. considering construction of State-aid road. Approx. cost, $241,000. C. E. Swank, Engr., Charleston.

Mo., Hillsboro—Jefferson Co., Commrs. considering constr. of 9.4 mile gravel road.

Est. cost, $47,000. H. D. Griffeth, Engr., Columbia.

Mo., Kansas City—Bd. Public Works contemplates repaving Twelfth St., Broadway to Troost St., also 14th St., Broad to Main Sts.

Mo., Kansas City—City considering extension to Ward Parkway, 71st St. to southern city limits. C. Hill, City Engr.

Mo., St. Joseph—Buchanan County Commrs. contemplate constructing 2.2 mi. asphalt conc. road on Pikes Peak highway. Est. cost $40,000. R. L. Cargill, Engr., St. Joseph.

Mo., Sedalia—Mo. State Hwy. Comn. has approved plan to construct 2.7 mile Warrenite brk. road—connecting St. Louis with Jefferson barracks. Est. cost $9,000 per mile.

Mo., Springfield—State Hwy. Comn. has approved constr. of 9-mi. brick pavement in Buchanan Co. Rd. will be about 16-ft. wide and cost approx. $35,000 per mile.

N. J., Atlantic City—Plans for paving Tuckahoe rd., Beach's cor. in Mays Landing to point beyond administration bldg., of Bethlehem Loading Co., approved by Atlantic county board of freeholders. Schedule forwarded to N. J. hwy. commission. If approved, bids will be called for and contr. awarded to begin work by October. Bd. also approved plans for paved rd. from Elwood to Amatol and is asking state aid on this work.

N. J., Newark—In response to request of manufacturers for better roads on the meadows, Director Raymond of Dept. Sts. & Public Impvts. will have Avenue R put in condition to bear heavy traffic; improve eastern end of Wilson Ave. (formerly Doremus Ave.) pave Wilson Ave., Ave. L to intersect. of what was formerly Doremus Ave. Will also consider completion of Delancey St. to connect with Ave. R.

N. J., Newark—Bd. of Commrs. adopted resolution to pave Woodland Ave., S. 10th St. to S. 13th St.; also Oriental Pl., Oriental Ter. to Mt. Pleasant Ave., with 6-in. conc. pavement; Oriental Ter. from Oriental Pl. to Oriental St., with asph. pavement on 6-in. conc. foundation. Thos. L. Raymond, director.

N. M., Albuquerque—Bernalillo Co. Commrs. considering paving Fourth Street and transforming street into "Alameda Blvd." Est. cost approx. $140,000.

N. M., Santa Fe—Survey for cement road 12 mi. south from Las Cruces, now complete and plans have been forwarded to Washington for approval.

Nev., Carson City—Plans completed for relocating road betw. this city and Reno. Est. cost $82,000. C. C. Cottrell, State Hwy. Engr.

Nev., Reno—Nev. Hwy. Dept. has accepted $20,000 from Lincoln Hwy. Assn. for road bldg. in Lander, Eureka and Churchill counties, with the understanding that an equal amt. be appropriated by state of Nevada. Constr. will begin within a few weeks if labor and materials can be secured.

N. Y., Manhasset—Two important hwys. will be improved in Hempstead from town's share of motor vehicle registration money. Archer G. Paterson, supt. of Hempstead hwys. will expend $24,374 on improvement of Hempstead-Babylon turnpike and $10,000 improvement of Washington avenue—Nassau road to Meadow Brook road. Contract to be awarded at once.

N. Y., Rochester—Monroe Co. Bd. of Supvrs. have appropriated $15,000 more of auto license funds for road impvts. Following roads will be improved: W. Town Line Rd., Gates, $3,000; Avon Rd., Rush, $2,000; Hamlin Center Rd., Hamlin, $3,000; River Rd., Henrietta, $4,000; Five-Mile Line Rd., Penfield, $3,000.

N. C., Kenansville—$45,000 available for improving county link of Wilmington-Goldsboro hwy., Duplin county.

N. C., Fayetteville—City will gravel Hillsboro and Rowan Sas., to connect with county road to Camp Bragg. J. C. McAllister, street supt.

O., Lorain—Co. Commrs. have conferred with officials public hwy., relative to improving the road betw. here and Oberlin along Green line trks. Approx. cost $23,000.

Ore., Klamath Falls—State Engr., J. H. Scott has complete survey of new rd.—Shippington hwy. via Pelican Bay sawmill to Fort Klamath rd.—Bids will be asked soon. Thos. Dixon Co. Rd. Supvr.

Ore., Portland—Capital Issues Comn. grants permission to issue bonds for improvement of certain streets in So. Portland tapping big shipbldg. plant in N. Portland. Work includes improvement of Wood street in So. Portland, Sherlock Ave. in N. Portland and Willamette boulevard on east side of river. Sewer work will also go ahead now that consent of government has been given.

Ore., Prineville—State Hwy. Engineer instructed by State Hwy. Comn., to survey proposed post road up Crooked River, with view of making it state hwy. The first 28 miles of the road will serve nine rural post offices with mail.

Okla., Chickasha—Grady Co. Commrs. contemplate expending $128,791 to build bridges and roads during year beginning July, 1918.

Okla., Henryetta—Commrs. Okmulgee county, very confident that work will start soon on construction of good roads. Bonds to extent of $800,000 voted for this work.

Tenn., Nashville—Hwy. Comn. has made appropriations of national and state funds for road bldg. in Anderson, Hawkins, Unicol, Cocke, Sullivan, Campbell, Madison & Maury Cos.—$30,000 to each. Comn. also approved surveys made in the different counties.

Tenn., Newport—$30,000 appropriation made by State Hwy., Nashville, to Cocke Co., for completion of 10-mile gap on Carolina division Dixie Hwy., which is routed betw. Knoxville and Asheville.
anything else besides trees and flowersfide

Tex., Bay City—Bond issue voted by Matagorda Co. Rd. District No. 8 for constructing wide shell boulevard—Bay City to Matagorda and from Matagorda to Big Hill Sulphur fields.

Tex., Dallas—Dallas County Commrs. will pave with asph. 13 miles of Waxahachie Rd., southern limits of Dallas in Oak Cliff, also 13 miles of Mesquite Rd. Total est. cost, $40,000. J. F. Witt, Co. Engr.

Tex., Galveston—Commrs. Galveston Co. requested by Lieut. L. B. Hyde, Constr. Engr. of Naval Air Service, to construct hwy. to connect with Government's perm. hwy. sys., at west end of air station site. Matter will be expedited in every way possible, as constr. work will soon begin on the $3,000,000 naval air station.

Tex., Hillsboro—Commrs. Hill Co., considering improving abt. 200 miles of roads. Est. cost $3,000,000.

Tex., Fort Worth—Business men from Hood, Brown and Comanche counties are endeavoring to enlist the aid of Fort Worth and Tarrant Co., in the construction of State Hwy. No. 10, Fort Worth-Cranbury-Brownwood road. Comanche Co. has already voted $320,000 bonds to build its part of this hwy. State and fed. aid promised in Brown and Erath Cos.

Utah, Ogden—State Rd. Comn. has approved plans and specifis. for nearly 10 miles paving in city and extending into Weber Co. Ogden portion of road extends for nearly 3 miles on Washington Ave., at width of 24½ ft. Est. cost $29,000 per mile. Jos. Tracy, City Engr. Bds. of Commrs., Ogden City and Weber Co. urged by Ogden publicity bureau to recommend bldg. of road suitable for heavy travel from 24th St. to site of Globe Grain & Milling Co., to anticipate heavy traffic when this company's bldg. program is under way.

Utah, Salt Lake City—Over 130 miles of state post rd. project awaits approval of Govt. officials at Washington. First of these projects will eventually provide a network of improved hwys. throughout state at cost of nearly one million, is already under consideration betw. Castle Gate and Duchesne. Surveys now being made of project No. 9—extending from Delta to Kanosh in Millard Co.

Va., Portsmouth—Govt. considering expendt. of $1,000,000 for road construction, of which several hundred thousand dollars will be spent in this vicinity. Rear-Admiral Harris, U. S. N., Washington, Pres. Bd. of Control, War Activities in Hampton Rds. District.

SEWERAGE AND SEWAGE TREATMENT.

Ala., Huntsville—Madison County Commrs., and City voted total of $7,500 toward constr. of sanitation system in county. State will contribute equal amount.

Ala., Tuscumbia—As soon as details can be perfected, City will issue bonds for constr. of sewerage system. Est. cost $150,000; 18 miles of sewers required.

Ala., Sayerton—Republic Iron Street Co., will construct sanitary sewer system, to include 300 septic tanks. Est. cost $25,000.

Ala., Talladega—$5,000 appropriated by Talladega Co. Commrs., toward construction of sanitation sys. in county. State will contribute abt. $5,000.

Ark., Morrillton—Plans being prepared for constr. of sewer system. Est. cost, $20,000. Harrington, Howard & Ash, Orear-Leslie Bldg., Kans. City, Engrs.

Ark., Paragould—City soon to ask bids for bldg sewerage system. Est. about $16,000. W. B. Rollins & Co., 209 Ry. Ex. Bldg., Kansas City, Mo., Engrs.

Cal., Los Angeles—National Issues Committee has approved 38 municipal projects which involve expenditure of $701,470 in this city this year. 21 of these projects are sanitary sewer jobs. Largest item in group is Gulf sewer in harbor district, which will cost $150,000; Florence avenue sewer will cost $120,000.

Cal., Porterville—Plans and specifications accepted by city officials for material extension of outfall sewer sys. to serve large area near south-western city limits. Bids to be asked in near future.

Cal., Sawtelle—Dr. L. M. Powers, City Health Commr., requests Bd. of Public Wks. to install sewers and other san. accommodations in Sawtelle. He reports sanitary conditions in annexed district are bad, due to lack of sewers, and measure should be devised to provide sewer system with outfall in ocean, or septic tank system.

Can., Ont., Sandwich—City officials considering construction of sewage system on Detroit and Royal Sts. Work will be started this Fall, if project materializes.

Conn., Bridgeport—Bd. of Contract and Supply will receive bids about September 15th for bldg. sewers in various streets. Abt. $60,000. J. A. McElroy, City Engr.

Ct., New London—Natl. Housing Co., soon to award contr. for bldg. sewers in Jefferson and Lincoln Aves., in connection with housing project. Abt. $15,000. L. L. Tribus, Engr.

Fla., Pensacola—City voted $50,000 bonds for constr. of sewer and drainage system, with disposal plant if necessary, for Emergency Fleet Corporation's townsite development (400 or more dwellings).

Fla., Tampa—City will build sewers at estimated cost of $15,000; mainly rein. conc.

Ga., Thomson—City will construct sewers at cost of $21,000. C. A. Farmer, Clk.; A. T. Sill, Engr.

Ill., E. St. Louis—City contemplates converting Cahokia Creek into sewer, thus giving city a big outlet sewer.

Ill., Springfield—Council passed three ordinances for laying of sewer in east part of City: in White City blvd.—Clear Lake ave. to Monroe st.; in White City blvd.—David to Monroe Sts.; and in the boulevard—Paul to Monroe Sts. Estimated costs, respectively: $1,236; $1,236 and $1,168.

Ia., Delle Plaine—Plans being prepared by J. F. Thorne, Engr., Howes Bldg., Clinton, for sewer system involving 3 block 8-in. vitr. sewer pipe. E. M. Ewen, City Clk.

Ky., Newport—City considering construction of storm sewer. Est. cost, $50,000. Jos. Hermann, City Engr.

La., Winnsboro—City contemplates bldg. sewers, water works and sidewalk. About $80,000. X. A. Kramer, Magnolia, Miss., Engr.

Mich., Detroit—All territory within limits of Ford village will be provided with sewerage connections, if bond issue for $149,565 is voted by at election September 17th.

Mich., Holland—Council considering construction of constructing sewage disposal plant. Committee investigating the matter.

Minn., Beaver Falls—Committee from this City will go to Harrisburg to confer with state authorities in regard to completion of outfall sewer.

Minn., St. Paul—City Council has passed ordinance for constr. of trunk sewer—4th St. to Broadway, down Broadway and in same direction through the railroad property to the Mississippi river. Est. cost, $53,014.

Mo., Kansas City—Bd. Public Wks. has approved Resolution providing for constr. of upper end of Town Fork sewer. Est. cost, $500,000.

Mont., Bozeman—City plans to construct sewers; also grade and pave Dis. No. 171. Abt. $30,120.

Mont., Billings—City contemplates bldg. storm sewer in 4th St. Est. cost abt. $107,000. Alvord & Burdick, 8 S. Dearborn St., Chicago, Ill., Engrs.

N. J., Dover—Definite scheme for installing sewers in city, outlined in report submitted to Mayor & Bd. of Aldermen by Bd. of Sewage Commrs. Est. cost of constructing laterals in streets, irrespective of house connections, $450,000. Bd. suggested that $300,000 bonds be issued.

N. J., Kearney—H. Ford, Detroit, Mich., plans to install Imhoffntank and complete sewerage disposal system at proposed plant being erected on Central Ave. here. A. Kahn, Marquette Bldg., Detroit, Archt.

N. Y., New York—Plans completed for sections of big trunk sewer to be laid in Hunters Point Ave., betw. viaduct over Long Island R. R. trks. to Van Dam street; plans also completed for one of the largest extension of laterals in Corona sewer district in Edson St.—51st St. to Peartree

Ave.; Ferguson St.—51st St. to Peartree Ave.; Gunther St.—51st St. to Peartree Ave.; Peartree Ave.—Pell St. to Kingsland Ave.; Tieman Ave.—Polk to Kingsland Ave.; Roosevelt Ave. and Havemeyer St.—51st St. to Peartree Ave. Est. cost of new sys., $150,000.

N. Y., Tonawanda—Preliminary steps taken by Town Bd., for constr. of sewer in Riverside distr. of this town. Agreement reached with city of Buffalo whereby sewage may be carried into city sys., from twp. sewer distrs. to be created in town.

N. C., Durham—$75,000 bonds will be issued to take care of necessary sewerage extensions in City.

O., Akron—Mayor & Aud., empowered by council to issue and sell notes aggregating $195,000 for purpose of constructing main trunk sewer in sewer district No. 4.

O., Coshocton—F. D. Stewart, Asst. Engr. of State Dept. of Health will investigate territory for which sewerage impvts. are proposed in south-eastern section of city—Orange St. to Kenilworth Ave.; So. Eighth St. to Cambridge Road. Engrs. Chester & Fleming, Pittsburgh, recently completed survey of this sec. and drew up plans providing for sewer facilities for all but 29 houses. State Engr. will also examine new reservoir and collect samples of public water supply.

O., Hamilton—Ord. passed for improvement of Ludlow St., 12th St., and 1 betw. Edison and Hensley Sts., by constructing san. sewers and house connections therein. Estimates and specifs. submitted by F. Weaver, Engr., for constr. of san. sewers and house connections on Dixie hwy.—Grand blvd. to Fox Ave.; Maple Ave.—Miami to Erie Canal to east line of lot No. 12815; Mill Road—High St. to Campbell Ave.; Vanderveer Ave.—Mill Rd. to alley east of Lockwood Ave.; Campbell Ave.—Mill Rd. to alley east of Lockwood. Main lines will cross under canal at Maple Ave. and connect with present sewer of canal; line on Dixie Hwy. will empty into main sewer line at Grand Blvd. and East Ave.

O., Hamilton—Resolution adopted providing that City Engr. draw up plans and specifs. relative to cost of extending san. sewers and constructing house connections along Dixie Hwy.

O., Lancaster—Resolution adopted to construct Utica sewer in Storm Wat. Sewer Dist. No. 13; also Wilson Ave. sewer in Storm Water Sewer Dist. No. 1, and Zane Alley Sewer Dist. No. 3. E. W. Mossman, Clk. of Council.

O., Lima—Capitol Issues Committee has approved bond issue of $155,000 for city's portion of expense of constructing new auxiliary sewer system. Forbes & McClintock, New York City, Engrs.

O., Mansfield—City offering for sale bonds in sum of $5,000 and $4,700 respectively, for construction of sewers—8-in. and 5-in. sanitary—in W. Park Blvd., Virginia Ave. and Ausdale Ave.; also Diamond and Ford Sts. C E. Rhoads, Aud.

O., Springfield—Constr. of storm sewer in Snyder Park to drain off water which floods park after heavy rain and silts up bed of lake, being considered. City Engr. M. J. Bahin has been instructed to draw up the plans.

O., Sandusky—Petition filed by property owners for sewer connections on Wayne, Lane and Sycamore Sts. Est. cost abt. $11,000.

Ore., Astoria—Council has declared its intention to construct sewer on Olney Ave.—from manhole in 7th St., to manhole to be constructed in sewerage and draing. distr. No. 5 at Fifth St. 16-in. salt-glazed vitr. sewer pipe; and from manhole on 6th St., westerly to manhole on Fifth St., 18-in. salt-glazed vitr. sewer; together with necessary way branches. Will also construct sewer on 48th St., from no. line of Cedar St. with 14-in. glazed vitr. sewer pipe.

Pa., Beaver Falls—Within next few months Beaver Falls may construct an outfall sewer line which will connect the sewerage disposal plant with Beaver river below Fallston dam. Bids will probably be asked in October.

Pa., Beaver Falls—R. Winthrop Pratt, Cleveland, O., selected to prepare plans for disposal system for Borough's sanitary sewer system.

Pa., Clairton—Town has adopted plans for constr. of municipal sewage disposal plant, large enough to accommodate town of 50,000 population.

Pa., Farrell—Council has approved plans submitted by Boro. Engr. Cole, for constr. of Haywood Hollow sewer. Est. cost approx. $66,000, if built of concrete or brk.; abt. $43,000, if segmental tile is used.

Pa., Johnstown—Ord. passed to issue $775,000 bonds for san. sewer; also constr. of garbage disposal plant.

Pa., Scranton—City will take bids in October or November for sanitary sewer in 21st Ward at $165,415. Wm. A. Schunk, City Hall, City Engr.

Pa., Sharon—City will construct sewer on Haywood Ave. Est. $46,000.

Pa., Sunbury—Northumberland Co. plans to build rein. conc. bridge over Chillisguan Crk. Abt. $18,000.

Pa., Wellsboro—At special election citizens voted on $24,000 bond issue for extension and bldg. of sewers.

San Domingo, Santiago de los Caballeros—Military Govt., of Dominican Republic has authorized installation of sewerage system in Santiago de los Caballeros; hence City Council desires to contract with company of good credit for this construction; work to be done in accord. with plans prepared by Engr. Bogaert. Est. cost, including that of laying rain water sewers of Fort San Luis, $160,000, to be divided as follows: iron material, $30,000; cement, $54,000; labor, $76,000. Work must commence abt. November 1st, 1918, and be completed within 18 months.

W. Va., Martins Ferry—City and Co. Engrs. are surveying for new sewer in Mackey addn., which is designed to carry off water from all that section which has been built up, part of it being just outside city limits.

Wis., Manitowoc—Council has voted to appropriate $50,000 for sewer mains in new district where Emerg. Fleet Corp., Philadelphia, Pa., is building houses for workers.

WATER SUPPLY AND PURIFICATION.

Ark., Camp Pike—War Dept. will construct water main from Booster's Sta., to Camp Pike, near Little Rock, to double supply.

Ark., Little Rock—Arkansaw Water Co. will drill 3 additional wells to increase water supply; may drill two or three more to maintain maximum daily capy. of 16,000,000 gals.

Cal., Coalinga—Plans being prepared by F. G. Dessery, Engr., Central Bldg., Los Angeles, for auxiliary pumping sys., at water works.

Cal., Fresno—Edison Company considering expenditure of $842,000 for construction of huge dam and conduit at Reservoir Creek. It is proposed to store water of Pitman Creek and divert portion of same to Big Basin reservoir with dimensions 103 ft. high, 860 ft. long on top and 50 ft. at bottom, of rein. conc., multiple arch buttress type. The water, after use in four power plants, will be returned to San Joaquin River from tail-race of plant No. 4, Madera County.

Cal., Santa Barbara—City will soon ask bids for water mains to connect Gibraltar dam with Mission Ridge reservoir. Abt. 5,000 ft. 18-in. and 10-in. pipe will be required. Robert A. Craig, City Mgr.

Can., Ont., Windsor—Plans prepared for construction of 12,000,000-gal. filtration plant. Est. cost betw. $250,000 and $300,000. Citizens will vote on bond issue in January.

Conn., Easton—Bridgeport Hydraulic Co., 820 Main St., Bridgeport, plans to construct new dam and reservoir. About $750,000. S. P. Senior, Engr.

Ill., Gillespie—Town will have system of water works. Warren Engrg. Co., Decatur, have made plan and drill will be on ground this week to drill wells. If sufficient supply is found system will be installed. If, on testing out the field, the supply is not found to be adequate, a reservoir system will be put in.

Ind., Crown Point—Plans and specifs., now in hands of architect firm of Smith & Wright for new cement storage reservoir which will soon be erected by City at water works plant, to be used for emergency supply of water, will be 50x100 ft. in dimensions; 10-ft. deep with capy. of 375,000 gal.

Ky., Stithton—War Dept. considering construction of water works system and installation of refrigerating plant, in connection with constr. of a cantonment.

Me., Kittery—$200,000 appropriation made by City for new water main to supply water to navy yard.

Md., Baltimore—Filtration plant will be enlarged immediately. Est. cost abt. $1,000,000. Extension of the plant, including new filter water reservoir, will use abt. 46 acres of land space.

Md., Brunswick—$125,000 bonds voted by City to increase water supply. Eugene L. Harrison, Mayor.

Md., Hagerstown—City Water Bd. will have surveys made with view to constructing sedimentation and purifying system; plans to convert old settling dam into sedimentation basin with daily capy. of 5,000,000 gals.; treat water with alum and chlorine. J. McPherson Scott, Pres.

Mich., Detroit, Highland Park—City Engr. instructed to submit plans and estimates for an increase of 40 per cent in filter bed equipment of filtration plant, now in process of construction. Present plans provide for 10 filter beds; the addn. of 4 units now (14 in all) would allow ample provision for future needs.

Mich., Wyandotte—City will construct filtration plant as quickly as possible. City Engr., Winthrop R. Pratt, estimates cost at $280,000 for a 6,000,000-gal. capy. filtr. plant. Comn. will take up, in near future, legal steps connected with bond issue to be submitted to voters.

N. J., Elizabeth—Bd. of Devel. & Conservation, Trenton, petitioned to approve plans for erection of water plant at junction of Raritan and Millstone rivers, near Bound Brook, Somerset County. Several water companies are the petitioners. It is planned by the consolidated companies to supply 20,000,000 gals. water with new plant. Map shows settling basin, filtration wks., and other appurts.

N. Y., Niagara Falls—Committee appointed to take up proposition of an addition to filtration pumping station. City Engr. W L. Bennett and Supt. of Public Service Chas. T. Shepard, report that it will require $400,000 to duplicate present filtration station.

N. M., Portales—$25,000 bonds sold to repair water works and sewerage sys.

N. Y.,—Watervliet—Bd. of Aldermen considering additions and improvements to the French Mill water supply. Est. cost, $130,000.

N. C., Wilmington—City will appropriate $35,000 to $40,000 to improve water supply system; contemplates deep wells with turbine pumps, semi-Deisel oil engines, electric generators and motors. J. Newton Johnston, City Engr.

O., Akron—Ord. passed to issue bonds in sum of $1,315,000 for purpose of enlarging, improving, repairing water works. H. N. Seiler, Clk.

O., Niles—City Council will issue $20,000 worth of bonds to provide funds for extending water mains to site purchased by Govt. for housing purposes.

Okla., Tulsa—City desirous of ascertaining from what source it can procure sufficient volume of water to supply its needs; also the cost thereof. Bids will be received until Sept. 20th from Hydraulic Engineers on cost of making surveys, estimates and obtaining opinions from these engineers as to advisability of obtaining said water supply. C. H. Hubbard, Mayor.

S. D., Pierre—$100,000 bonds voted by citizens for reconstruction of water and electric light plant, recently destroyed by fire.

Tex., Waco—N. Werenskiold, Engr., Dallas, will be engaged by City to prepare plans and specifs. and to supervise constr. of settling basin at filtration plant, Vermont and Third Sts. Dimensions: 280x90 ft. with depth of 9½ ft.; capy., 5,000,000 gals.; mixing basin at so. end of basin connected with two 30-in. mains. Est. cost, $25,811.

Va., Petersburg—City will improve water works to increase supply and provide for Camp Lee. Improvements include 2 additional pumps at intake on Va. Power & Passenger Co's. canal, with capy. of 400,000 gals. per min.; pipe line requiring 12, 14 and 16-in. mains; additional tanks; 3 filters with capy. of 1,500,000 gals.; cost, $150,000, of which Govt. will pay 25 per cent. Jno. E. Herrek, Chrmn., Water Comm.

Va., Portsmouth—Portsmouth, Berkley & Suffolk Water Co. will improve plant (financed by Government) in order to increase daily capy. from 7,500,000 gals. to 12,000,000 or 14,000,000 gals.

Va., Portsmouth—$33,000 appropriated by city for constructing water sys. to naval training station. Chas. E. Ashburner, City Mgr. (Portsmouth, Berkley & Suffolk Water Co.) lately noted to improve plant, financed by Govt. to increase daily capy. from 7,500,000 to 12,000,000 or 14,000,000 gals.

Wn., Bellingham—City will install chlorination plant to purify water supply from Lake Whatcom. Work will be done in cooperation with owners of Fairhaven water system, who have been ordered by Government to install such a plant.

Wn., Republic—Republic Water Co. contemplates installing two water tanks on site of present one on hill above Clark Ave.—60,000-gal. capy.

Wn., Seattle—Bd. Public Improvements considering laying water mains in E. Marginal Way and Mich. St., at est. cost of $165,000.

W. Va., Fairmount—City contemplates purchase of new electric pump and transformers for water works. Est. cost, $13,200; also base connections and installations, $15,000. Smith & Barnes, City Commrs. S. B. Miller, Engr.

BRIDGES AND BUILDINGS

Ark., Marshall—Searcy Co. Commrs. will build 3 steel bridges in connection with road improvements.

Cal., Riverside—Construction of bridge betw. Temecula and Murrietta Springs, being considered. A. L. Fulmore, Engr., Riverside County.

Cal., Willows—Plans approved by Glen Co. Supvrs., for repair of Butte City brdg. over Sacramento River to be made at approx. cost of $25,000; plans also approved for bldg. 9 small conc. brdgs. and culverts throughout the county.

Ia., Davenport—Plans in progress by City Engr. Roscoe E. Sawistowsky, for constr. of bridge over Duck Creek on N. Brady St., at $12,000.

Kans., Ark. City—Cowley Co. had plans prepared by Herrington, Howard & Ash, Engrs., Orear-Leslie Bldg., Kans. City, Mo., for Country Club brdg., 230 ft. long, consisting of 5 46-ft. gird. spans, with 20 ft. rdway. About $17,000.

Kans., Winfield—Plans prepared by Harrington, Howard & Ash, Orear-Leslie Bldg., Kansas City, Mo., for constr. of 9th Ave. brdg., consisting of one 106-ft. conc. arch span with four 30-ft., two 20-ft. and two 19-ft. girder spans. 20-ft. clear rdway. Abt. $25,000. Cowley County.

Me., Portland—$100,000 will have to be expended for repairs to new million dollar bridge here. Bulkhead in center of bridge, under the draw, has settled six ft. on sandy bottom and caused wide curvature in one part of brdg.

Me., Portland—Concrete bridge will be erected over Songro river betw. Naples and Casco to replace Red River brdg. Est. cost, $17,300.

Mass., Charlton—Bids to be asked in near future for rein. conc. brdg. $32,000 available. Edw. A. Lamb, Chmn. of Selectmen.

Mich., Detroit—Mich. Cent. and N. Y. Central Rys. having plans prepared for 125-ft. clear span double trk. Strauss bascule brdg. over River Rouge, West Detroit. About $540,000. J. F. Deimling, Passenger Tem. Sta., Engr.

Minn., Foley—Plans completed for constr. of Bridge 2977, 60-ft. span. Est. cost, $8,000; also for Brdg. 2972. J. E. Kasmer, Co. Aud., State Hwy. Dept., Guardian Life Bldg., St. Paul.

Mo., St. Louis—B. F. Bush, Direct. Railroads, recommends to Govt. that extensions be made to Municipal Bridge. Cost, $8,000,000. Proj. includes no. and so. connect. of brdg. with tracks of Ill. Transfer Co., at E. St. Louis, Ill.; additional connections and interlocking plants betw. E. St. Louis line to permit routing trains to east approach of brdg.; elevated structure and approach from Relay Depot, E. St. Louis, to Municipal Brdg.; So. St. Louis approach at west end of brdg. in St. Louis, Mo.

Mont., Billings—Govt. will furnish monetary aid for reconstruction of Huntley brdg. over Yellowstone and for replacing another bridge four mi. from here. Chas. A. Kyle, Member of State Hwy. Comn.

Mont., Butte—Another attempt to be made to replace wooden brdg. over Silver Bow crk. on So. Montana St., with conc. structure. Est. cost, $12,000.

N. Y., Olean—Concrete bridge will be built over Two Mile creek at Buffalo St. Supt. of Street instructed to ask bids for this work.

N. Y., Rochester—Monroe Co. Bd. of Supvrs. considering replacing present float bridge. Est. cost abt. $20,000; also new brdg. to replace present one on Rochester-Scottsville road over Black Crk., at est. cost $10,943.

O., Marion—Plans being drawn by Acting Co. Surv., Chas. Ash, for constr. of rein. conc. bridge over Little Scioto on Marion-Kenton Pike. Bridge will be 3 spans, one of 40 ft. and two of 20½ ft.

Okla., Miami—Ottawa Co. Commrs. considering constr. of bridges and culverts at cost of $90,000. A. Stein, Engr., Miami.

Okla., Sallisaw—I. H. Nakdimen, Fort Smith, Ark., will purchase the $500,000 bridge bonds if Govt. will permit constr. of bridge across the Arkansas river here. The bridge will, when built, connect Fort Smith, Ark., with Sequoyah, Okla.

Pa., Bethlehem—Public Service Comn. has approved plans for bldg. a $1,500,000 hill-to-hill bridge here. Construction will probably begin soon.

Pa., Pittsburgh—If Priority Bd. will agree to allow Allegheny Co. Commrs. priority order to secure necessary material, labor, etc., for its constr., the new Sixteenth St. bridge over the Allegheny River will be built as speedily as possible.

Va., Hillsville—Carroll County had plans prepared for bldg. bridge over Crooked Creek, Bouers Ford. Abt. $50,000.

Va., Spotsylvania—Reconstruction of all bridges in Spotsylvania County being considered. $10,000 available.

Wn., Montesano—Five bridges on Olympia highway betw. Aberdeen and here are to be rebuilt. H. S. Shorey, Co. Engr.

Wn., Tacoma—Plans being prepared for constr. of two concrete bridges to replace wooden structures on National Pk. Hwy., Chop Valley. Est. cost of each, $6,000. D. H. White, Co. Engr.

Wis., Janesville—Janesville has voted in favor of $70,000 bond issue for constr. of bridge on S. Jackson Street.

Wis., Madison—Plans approved for conc. bridge over Starkweather Crk. on Milwaukee Street. Cost, $3,700.

Wis., Sheboygan—Plans completed by Engrs., Klug & Smith, Moak Bldg., Milwaukee, for steel bridge, 220 ft. long, 60 ft. bascule span, 24 ft. rdway, 2 7-ft. walks, conc. abuts, monolithic brk. pavements. C. U. Bole, Engineer.

Wis., Wausau—Marthon County considering constr. of rein. conc. and steel bridge, consisting of 7 30-ft. spans. Abt. $12,500.

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Of MUNICIPAL AND COUNTY ENGINEERING, published monthly at Indianapolis, Indiana, for October 1, 1918.

State of Indiana, County of Marion, ss:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Alexander P. Fox, who, having been duly sworn according to law, deposes and says that he is the President of MUNICIPAL AND COUNTY ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Engineering Publishing Company, Inc., Indianapolis, Indiana.

Editor, Samuel C. Hadden, 538 South Clark Street, Chicago, Illinois.

Managing Editor, Samuel C. Hadden.

Business Manager, J. H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

2. That the owners are:

Engineering Publishing Company, Inc., Indianapolis, Indiana.

A. P. Fox, 704 Wulsin Building, Indianapolis, Indiana.

George O. Wildhack, 927 North Meridian Street, Indianapolis, Indiana.

J. H. Pritchard, 702 Wulsin Building, Indianapolis, Indiana.

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:

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A. P. FOX, President.

Sworn to and subscribed before me this 25th day of September, 1918.

(Seal) JOHN H. PRITCHARD.
(My commission expires June 18, 1922).

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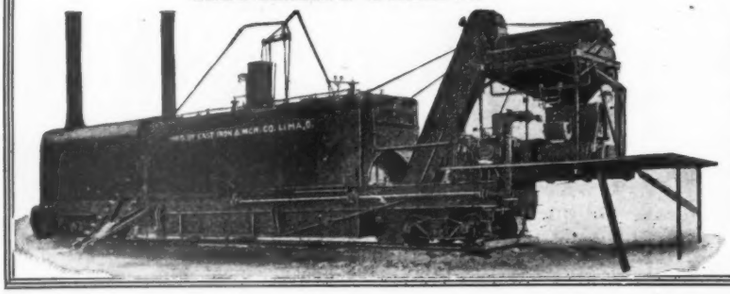

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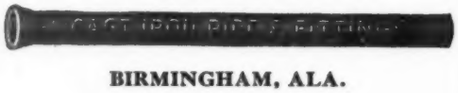

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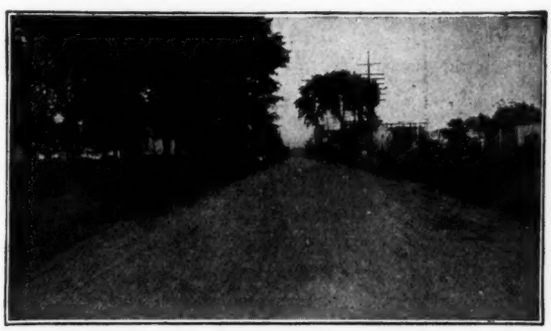
Van Trump, Isaac, Chicago, Ill	35
Warren Brothers Co., Boston, Mass	1
Warren Foundry and Machine Co., New York, N. Y	7
Waterloo Cement Machinery Corp., Waterloo, Ia	
Wilson Co., J. C., Detroit, Mich	back cover
Wisconsin Motor Mfg. Co., Milwaukee, Wis	23

THE STANDARD METHOD OF SURFACE TREATMENT

Stanolind Paving Asphalt is applied with a pressure tank wagon made especially for this work, as shown in illustration to the left.

Water Bonded Gravel Road after being treated with Stanolind Paving Asphalt at 300° F., 45 lbs. pressure, applied with special pressure tank wagon, one-half gallon to the square yard.



Water Bonded Macadam Road after being treated with Stanolind Paving Asphalt at 300° F., 45. lbs pressure, applied with special pressure tank wagon, one-half gallon to the square yard.

One application of Stanolind Paving Asphalt on macadam or gravel roads has given three years service with practically no expense. Builds more substantial surface at half the cost of light oil treatment for three years. Can be applied on roads previously treated with Road Oil.

Write today for free booklet *"Stanolind Paving Asphalt."*

STANDARD OIL COMPANY

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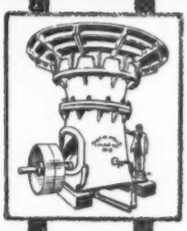

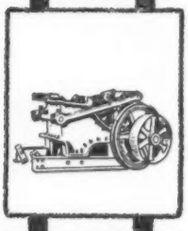

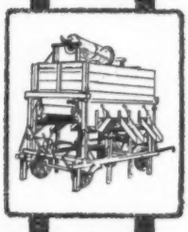

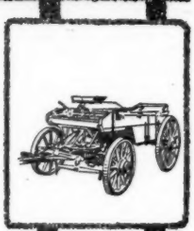

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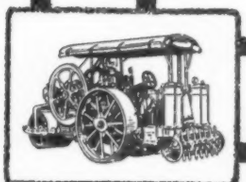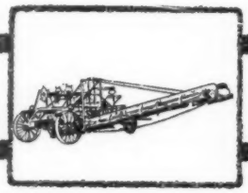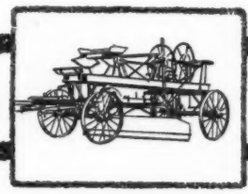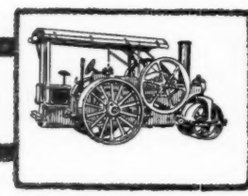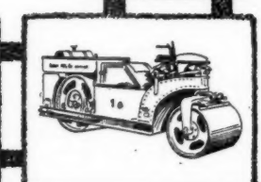
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